Environment

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Technical Memorandum
Alternatives Screening

Pines Area of Investigation
AOC II
Docket No. V-W-’04-C-784

Submitted by:
AECOM
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Disclaimer

This document is a document prepared under a federal administrative order on consent.

The first four chapters of this document were provided to the United States Environmental Protection Agency (USEPA) in the Remedial Action Objectives Technical Memorandum in January 2012. USEPA provided comments on these chapters in a letter dated April 18, 2012. ~~These chapters have been revised per the responses to these comments, which are provided in Appendix A. This memorandum provides the first draft of Chapters 5 and 6, which have not undergone formal review by the USEPA. The opinions, findings, and conclusions expressed are preliminary and are those of the authors and not necessarily those of USEPA.~~

The last two chapters of this document were provided to the USEPA in the Alternatives Screening Memorandum in June 2012.

USEPA provided comments on all chapters in a letter dated August 31, 2012. All chapters have been revised per the responses to comments, which are provided in Appendix A.

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List of Acronyms

AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
AUF	Area Use Factor
BERA	Baseline Ecological Risk Assessment
BTV	Background Threshold Value
bgs	below ground surface
CCB	Coal Combustion By-product
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic foot per second
CMC	Criterion Maximum Concentration
COC	Constituent of Concern
COPC	Constituent of Potential Concern
COPEC	Constituent of Potential Ecological Concern
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
DO	Dissolved Oxygen
EPC	Exposure Point Concentration
EPRI	Electric Power Research Institute
ERA	Ecological Risk Assessment
ESV	Ecological Screening Value
FS	Feasibility Study
GQS	Groundwater Quality Standard
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IDEM	Indiana Department of Environmental Management
IDNL	Indiana Dunes National Lakeshore
LOAEL	Lowest Observed Adverse Effect Level
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg/L	Milligram per Liter
MWSE	Municipal Water Service Extension
NCP	National Contingency Plan
NIPSCO	Northern Indiana Public Service Company
NOAEL	No Observed Adverse Effect Level
OSWER	Office of Solid Waste and Emergency Response
pCi/g	PicoCurie per Gram
RAL	Removal Action Level
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose

RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RISC	(State of Indiana's) Risk Integrated System of Closure
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
ROW	Right-of-Way
SAB	Scientific Advisory Board
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SERA	Screening-Level Ecological Risk Assessment
SMC	Secondary Maximum Concentration
SMDP	Scientific/Management Decision Point
SMS	Site Management Strategy
SOW	Statement of Work
SWQS	Surface Water Quality Standards
TBC	To Be Considered
TOC	Total Organic Carbon
~~TP~~	~~Test Pit~~
TRV	Toxicity Reference Value
TSS	Total Suspended Solids
ug/L	micrograms per liter
UCL	Upper Confidence Limit
UMTRCA	Uranium Mill Tailings Radiation Control Act
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WQC	Water Quality Criteria

Standard Chemical Abbreviations

Al	Aluminum
As	Arsenic
B	Boron
Ba	Barium
Cd	Cadmium
Ca	Calcium
Cl	Chlorine
Co	Cobalt
Cr	Chromium
Cr (VI)	Hexavalent Chromium
Cu	Copper
Fe	Iron
Hg	Mercury
HCO_3	Bicarbonate
K	Potassium
Mn	Manganese
Mg	Magnesium
Mo	Molybdenum
Na	Sodium
Ni	Nickel
NO_3	Nitrate
NH_4	Ammonia
Pb	Lead
Po	Polonium
Ra	Radium
S	Sulfur
Se	Selenium
Si	~~Silico~~Silicon
SO_4	Sulfate
Sr	Strontium
Tl	Thallium
Th	Thorium
U	Uranium
V	Vanadium
Zn	Zinc

1.0 Introduction

In April 2004, the United States Environmental Protection Agency (USEPA) and the Respondents (Brown Inc., Ddalt Corp., Bulk Transport Corp., and Northern Indiana Public Service Company (NIPSCO)) signed an Administrative Order on Consent (AOC II) (Docket No. V-W-'04-C-784) to conduct a Remedial Investigation and Feasibility Study (RI/FS) at the Pines Area of Investigation, located in the environs of the Town of Pines, Indiana, as set forth in Exhibit I to AOC II (AOC II, 2004). AOC II (Section VII. 22) and its attachment, the Statement of Work (SOW) (Tasks 6 and 7), require the Respondents to identify remedial action objectives (RAOs) and develop and evaluate a range of appropriate remedial options that meet the RAOs for the Pines Area of Investigation. A Technical Memorandum summarizing the RAOs for the Area of Investigation was submitted to the USEPA in January 2012 (AECOM, 2012a), and USEPA comments on that memorandum were received on April 18, 2012. Responses to USEPA comments are provided as Appendix ~~A~~A1, and are incorporated into ~~this~~that document as required. ~~This document presents the Alternatives Screening~~ A Technical Memorandum~~, which summarizes~~ summarizing the development and screening of remedial alternatives in accordance with AOC II and Task 7 of the SOW~~.~~ was submitted to the USEPA in June 2012 (AECOM, 2012b), and USEPA comments on that memorandum were received on August 31, 2012. Responses to USEPA comments are provided as Appendix A2, and are incorporated into this revised Alternatives Screening Technical Memorandum.

The remainder of this section provides a brief description of the Pines Area of Investigation (Section 1.1) and the historical background of the project (Section 1.2), a description of the Feasibility Study (FS) process for the Area of Investigation per AOC II (Section 1.3), a review of USEPA and other guidance documents used to prepare this Technical Memorandum (Section 1.4), and a summary of the remaining sections of this Memorandum (Section 1.5).

1.1 Description of the Pines Area of Investigation

The Pines Area of Investigation is located immediately west of the city limits of Michigan City, Indiana, and about 4,500 feet south of the southern shore of Lake Michigan (see Figure 1). The area is located primarily in the Town of Pines, in Porter County, Indiana, and encompasses approximately 1,450 acres (2.3 square miles). The Indiana Dunes National Lakeshore (IDNL), managed by the National Park Service, is located between Lake Michigan and the Town of Pines; a small portion of the IDNL is included within the Area of Investigation.

The Area of Investigation is sectioned in the east-west direction by two major roadways, US Route 12 (West Dunes Highway) in the northern portion, and US Highway 20 in the central portion. An east-west railroad bisects the central portion of the Area of Investigation. A major utility corridor runs parallel and just to the north of US Route 12. The IDNL comprises the portion of the Area of Investigation north of the utility corridor. Both residential and commercial establishments are located along US Route 12, and the area just south of US Route 12 consists mainly of single-family homes, located mainly along the uplands of the dune-beach complex topography that characterizes this area of northern Indiana. South of the residential areas, and north of the railroad are wetlands characteristic of the swale topography. These wetlands are now drained by the east and west branches of the man-made Brown Ditch, which was constructed to improve drainage and prevent flooding in the area. The confluence of the east and west branches of Brown Ditch is located approximately in the center of the Area of Investigation, where Brown Ditch then flows north into the

IDNL (Figure 2). Within the IDNL the ditch takes a turn due east and flows into Kintzele Ditch, which then flows to Lake Michigan.

The Area of Investigation contains residential areas, the majority of which are located between US Route 12 and US Highway 20. Additional residences are located mainly along Ardendale, Railroad Avenue, and Old Chicago Road. Each house historically may have had its own drinking water well or septic system or both. Figure 3 shows the portion of the Area of Investigation that has been provided municipal water service in accordance with AOC I (2003) and the Amendment to AOC I~~.~~ (2004). It is expected that septic systems will continue to be used in this community (i.e., there is no municipal sewage system).

Yard 520, a closed Restricted Waste Facility permitted by the Indiana Department of Environmental Management (IDEM), is located in the western portion of the Area of Investigation, between US Route 20 to the north and Brown Ditch and the railroad to the south. Yard 520 was previously used for the disposal of coal combustion by-products (CCBs) primarily from NIPSCO's Michigan City Generating Station, and was closed between 2004 and 2007. Two former dump sites, the Pines Landfill (owned by Waste Management) and the Lawrence Dump are located in the area to the south of Yard 520 and the railroad and north of Old Chicago Road (Figure 2).

In addition to the CCBs disposed of at Yard 520, suspected CCBs have also been observed in roadbed and other areas in certain portions of the Area of Investigation. Figure 4 depicts the information compiled about the potential locations of CCBs at the ground surface within the Area of Investigation, based on the information presented in the Remedial Investigation (RI) Report (AECOM, 2010).

1.2 Historical Background and Previous Remedial Actions

Between 2000 and 2004, IDEM and USEPA conducted sampling of private wells in a portion of the Town of Pines. Boron (B) and molybdenum (Mo) were detected in some samples at concentrations above USEPA Removal Action Levels (RALs) (USEPA, 1998). USEPA suspected that these concentrations above USEPA RALs were derived from CCBs because CCBs were disposed of in Yard 520 and CCBs were reported to have been used as fill in areas within the Area of Investigation outside of Yard 520.

To address the B and Mo detections above the USEPA RALs, the Respondents agreed to extend Michigan City's municipal water service from Michigan City to designated areas in the Town of Pines. This agreement was documented in an Administrative Order on Consent, referred to as AOC I, dated February 2003 (AOC 1, 2003). Subsequent sampling of additional private wells within the Area of Investigation indicated some concentrations near or exceeding these RALs. To address these exceedances, the Respondents approached the USEPA about extending the municipal water service to a larger area, under the AOC I, amended, dated April 2004 (AOC 1, 2003). The areas that received municipal water service are identified and shown in Figure 3. In all, the Respondents provided municipal water to more than 290 residences and businesses in this area. In addition to extending the municipal water service, AOC I (amended) includes a provision to offer bottled water to those residences within the Area of Investigation not connected to municipal water. The cost for this remedial action is $5,255,000, including the provision of bottled water to residents outside of the MWSE area who have requested this service to date. Note that the Respondents voluntarily chose to provide the extended municipal water service identified under the Amendment to AOC I, and that this response occurred well in advance of the conclusion of the RI/FS process.

Yard 520 was closed between 2004 and 2007, and the cost for this remedy was $1,524,000.

Concurrently with AOC I, amended, USEPA and the Respondents entered into a second AOC, referred to as AOC II (AOC II, 2004). Under AOC II, the Respondents committed to conduct an RI/FS for the Area of Investigation.

1.3 RI/FS Process for the Pines Area of Investigation

The objectives of the RI/FS, as stated in AOC II, include:

> (a) to determine the nature and extent of contamination at the Site and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances, pollutants or contaminants related to coal combustion by-products ("CCB") at or from the Site.
>
> (b) to collect data necessary to adequately characterize…(i) whether the water service extension installed pursuant to AOC I and AOC I as amended is sufficiently protective of current and reasonable future drinking water use of groundwater in accordance with Federal, State, and local requirements, (ii) any additional human health risks at the [Area of Investigation] associated with exposure to CCBs; and (iii) whether CCB-derived constituents may be causing unacceptable risks to ecological receptors; and,
>
> (c) to determine and evaluate alternatives for remedial action to prevent, mitigate, control or eliminate risks posed by any release or threatened release of hazardous substances, pollutants, or contaminants related to CCBs at or from the Site, by conducting a Feasibility Study.

Thus, AOC II recognizes that a major response action was conducted under AOC I, and that one objective of the remaining investigation was to determine if this response was sufficiently protective, or if additional response actions should be considered.

Performance of these objectives is accomplished through ten (10) tasks, as described in Part VII of AOC II (Work to be Performed). Tasks 1 through 5 have been completed, and are documented in the following reports:

- Site Management Strategy (SMS) (ENSR, 2005a): This document summarized the available information about the geology and hydrogeology of the area and the historical placement of CCBs within the Area of Investigation, presented a preliminary conceptual model, identified data gaps, and outlined the general approach to the RI/FS.
- RI/FS Work Plan, Volumes 1-7. (ENSR, 2005c).
- Additional sampling work plans for the RI Field Investigation, including the Municipal Water Service Extension (MWSE) Sampling and Analysis Plan (SAP) (ENSR, 2004), and the Yard 520 SAP (ENSR, 2005d).
- RI Report (AECOM, 2010): this report documents the results of the RI conducted at the Pines Area of Investigation in accordance with AOC II. This report provides the results of the RI Field Investigation activities and a conceptual site model for the CCB-derived constituents in environmental media at the Area of Investigation.
- Human Health Risk Assessment (HHRA) (AECOM, 2011a) and Screening-Level Ecological Risk Assessment (SERA) (AECOM, 2011b).

Task 6 is Identification of RAOs. This task states that the Respondents shall submit a RAO Technical Memorandum consistent with the SOW, and based on the results of the HHRA and SERA. This Memorandum was submitted to the USEPA in January 2012 (AECOM, ~~2012~~2012a), and identified RAOs specific to the Pines Area of Investigation considering the following (AOC II SOW):

- Prevention or abatement of unacceptable risks (current and/or reasonable future) to nearby human populations (including workers), animals, or the food chain from hazardous substances, pollutants, or constituents associated with CCBs.
- Prevention or abatement of unacceptable risks (current and/or reasonable future) associated with CCBs due to exposures including drinking water supplies and ecosystems.
- Acceptable constituent levels, or range of levels, for appropriate site-specific exposure routes.
- Mitigation or abatement of other situations or factors that may pose threats to public health, welfare, or the environment.
- A preliminary evaluation of Applicable or Relevant and Appropriate Requirements (ARARs).

USEPA provided comments on the RAO Technical Memorandum on April 18, 2012. Responses to these comments are provided in Appendix ~~A~~A1. Revisions to the text ~~have been~~were made as required in ~~this document~~the Alternatives Screening Technical Memorandum.

~~This document provides the~~ The Alternatives Screening Technical Memorandum was submitted to the USEPA in June 2012 (AECOM, 2012b), as required under Task 7. ~~Under~~In this ~~task~~Memorandum, potential remedial alternatives that ~~would~~ address the established RAOs ~~are~~were presented and summarized ~~in an Alternatives Screening Technical Memorandum. This~~. The memorandum ~~identifies~~also identified and ~~assesses~~assessed a limited number of alternatives appropriate for addressing the RAOs. Per AOC II, the Alternatives Screening Memorandum ~~includes~~included descriptions of technologies that were eliminated from consideration, including the basis for such elimination. Preliminary screening ~~is~~was based on permanence, effectiveness, implementability, and order of magnitude cost. The outcome of the Alternatives Screening ~~is~~was a short list of alternatives that will undergo detailed analysis in the FS.

USEPA approved and provided comments on the Alternatives Screening Memorandum on August 31, 2012. The memorandum has been revised per the responses to these comments, which are provided in Appendix A2.

Task 8 is the FS. The FS will include a detailed analysis of the alternatives that represent viable approaches to remedial action within the Pines Area of Investigation. The detailed analysis will consist of an assessment of individual alternatives relative to nine evaluation criteria set forth in 40 CFR 300.43(e)(9)(iii), and a comparative analysis that focuses upon the relative performance of each alternative against those criteria.

1.4 USEPA and Other Guidance Used to Conduct the FS

Per the SOW, the RI/FS is conducted consistent with the Guidance for Conducting Remedial Investigations and Feasibility Studies under ~~CERCLA~~the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (USEPA, 1988) and additional appropriate USEPA guidance. Thus, the identification of RAOs has been conducted consistent with the RI/FS guidance and the following Office of Solid Waste and Emergency Response (OSWER) directives:

- USEPA, 1989b. A Guide on Remedial Actions for Contaminated Ground Water. OSWER 9283.1-1FS, April.
- USEPA, 1992. Considerations in Ground-Water Remediation at Superfund Sites and RCRA [Resource Conservation and Recovery Act] Facilities – Update. OSWER 9283.1-06, May.
- USEPA, 1996. Ground Water Cleanup at Superfund Sites. EPA 540-K-96 008, December.
- USEPA, 1997. Implementing Presumptive Remedies. EPA 540-R-97-029, October.

- USEPA, 1999. A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents. EPA 540-R-98-031, July.

1.5 Report Organization

The remaining sections of this Technical Memorandum provide the following in support of developing RAOs and remedial alternatives for the Pines Area of Investigation:

- Section 2.0 provides a summary of the RI, HHRA and SERA Reports relative to the information necessary to develop RAOs;
- Section 3.0 provides a preliminary evaluation of ARARs;
- Section 4.0 identifies the RAOs;
- Section 5.0 identifies general response actions and areas within the Area of Investigation to which the general response actions apply;
- Section 6.0 provides the alternatives screening documentation, including identifying and screening remedial technologies, and assembling and screening remedial alternatives; and
- Section 7.0 provides references cited in this Memorandum.

2.0 Summary of the Remedial Investigation, Human Health Risk Assessment, and Ecological Risk Assessment

This section presents a summary of the RI (AECOM, 2010), HHRA (AECOM, 2011a) and the SERA (AECOM, 2011b), in particular concentrating on the portions of those Reports that are relevant to identifying RAOs for the Pines Area of Investigation.

2.1 Setting of the Pines Area of Investigation

Characteristics of the Pines Area of Investigation that are relevant to this Technical Memorandum include Geology and Hydrogeology, Surface Water, and Suspected CCBs.

2.1.1 Geology and Hydrogeology

Groundwater is present beneath the Area of Investigation in the shallow surficial aquifer made up primarily of wind-blown sands associated with the current and former shores of Lake Michigan. The base of the surficial aquifer is formed by a clay confining unit. The surficial aquifer is thickest beneath upland dune areas, is thinner beneath low-lying wetlands areas between the dunes (such as the Great Marsh in the IDNL), and pinches out completely to the south against the silts and clays of the Valparaiso Moraine and/or lacustrine sediments of Glacial Lake Chicago. A geologic cross-section is shown in Figure 5. Regionally, groundwater is also present in deeper, confined aquifers in the area, but the RI demonstrated that these could not be impacted by CCB-related constituents; therefore, the RI focused primarily on groundwater in the shallow, surficial aquifer.

Groundwater characteristics and behavior in the Area of Investigation shallow, surficial aquifer are straightforward and are typical of such aquifers. Groundwater occurs as a water table aquifer (in the surficial aquifer) at depths ranging from near the ground surface (in wetland areas) to approximately 25 ~~ft~~feet beneath upland dune areas. Groundwater flow is generally from the upland areas to Brown Ditch and its tributaries and wetlands located in the low-lying areas, including within the IDNL. In general, during both wet and dry periods, groundwater discharges to the Brown Ditch system (including associated tributaries and wetlands) throughout the Area of Investigation. A groundwater contour map is shown on Figure 6. While there might be a few instances where this gradient is reversed, these conditions are short-term and local, and do not affect the overall groundwater flow.

Seasonally, groundwater levels fluctuate approximately one to two feet, with water levels lower in the summer and fall (growing season) and higher in the winter and spring. Based on data collected during the RI, the hydraulic gradients and directions of groundwater flow do not change seasonally.

The hydraulic conductivity of the surficial aquifer was tested during the RI (slug testing) with estimated values ranging from approximately 5 to 50 feet/day with a geometric mean of 14.7 feet/day, consistent with the fine sands of the surficial aquifer. An average linear groundwater velocity of approximately 0.5 feet/day was calculated.

2.1.2 Surface Water

The Brown Ditch system is defined as the main branches of Brown Ditch, its associated tributaries and wetlands, including portions located within the IDNL, and makes up the low-lying wetland areas located both north and south of the Town of Pines. The system includes man-made ditches (e.g., Brown Ditch itself), excavated more than 100 years ago to provide drainage in these areas where the water table is shallow. Brown Ditch is a low-gradient channel with low surface water flow volumes and velocities. As measured during the RI, surface water flow rates range from less than one cubic foot per second (cfs) to more than five cfs. Flow rates vary in different branches of the ditch system and are generally higher in the winter and spring and lower in the summer.

2.1.3 CCBs and Suspected CCBs

There are three types of CCBs relevant to the Area of Investigation, as discussed in the SMS (ENSR, 2005a). Their classification is based on how and when they are generated in the coal combustion process. Bottom ash and boiler slag settle to the bottom of the combustion chamber. Fly ash is also generated in the combustion chamber, but it is lighter and finer than the bottom ash and boiler slag and so is transported in the flue gas and ultimately collected by air emission controls (e.g., electrostatic precipitators or other gas scrubbing systems) (U.S. Geological Survey (USGS), 2001). These residues are considered to be by-products because there are many beneficial re-uses for these materials (USGS, 2001).

CCBs are present in Yard 520, a closed Restricted Waste Facility permitted by IDEM that is located in the western portion of the Area of Investigation, between US Route 20 to the north and Brown Ditch and the railroad to the south. Yard 520 was previously used for the disposal of CCBs primarily from NIPSCO's Michigan City Generating Station, and was closed between 2004 and 2007. Although CCBs are present at Yard 520, direct contact with them is an incomplete exposure pathway as the facility is capped and closed.

Suspected CCBs have also been observed in roadbeds and other areas in certain portions of the Area of Investigation.

It is important to recognize that the CCBs present in Yard 520 and suspected CCBs within the Area of Investigation are not the same materials. The material observed during the water service installation included a large percentage of coarse grained material (larger than silt and clay), and the sidewalls of the trenches stayed upright during the utility work. In contrast, the material in Yard 520 was observed to be predominantly very fine grained, soupy or muddy, and would not stay upright on an open face. Based on descriptions from Brown Inc., the material brought to Yard 520 was a wet slurry which needed draining/dewatering. This material would not have been suitable for fill or road sub-base. The observed differences indicate that the CCB material in Yard 520 is primarily fly ash, while the suspected CCB material in the Town of Pines consists of a larger portion of bottom ash and/or boiler slag. Therefore, the materials have different physical and chemical characteristics. Fly ash generally has higher constituent concentrations than bottom ash or boiler slag (Electric Power Research Institute (EPRI), 2010), and this relationship has been demonstrated in the comparison of the radionuclide and metals data between samples collected from Yard 520 and samples collected during the municipal water service extension.

2.2 Remedial Investigation

The RI was completed in accordance with the USEPA-approved RI/FS Work Plan (ENSR, 2005c), including the Field Sampling Plan (Volume 2) and the Quality Assurance Project Plan (Volume 3). The RI consisted of an extensive field investigation including installation of groundwater monitoring wells; geologic and hydrogeologic studies; sampling and laboratory analysis of groundwater, surface water, sediments, background soils, and suspected CCBs; and evaluation of ecological habitats. The analytical results provide a comprehensive dataset with which to evaluate the nature and occurrence of CCB-derived constituents within the Area of Investigation.

The results of the RI are documented in the RI Report. In addition to providing the results of the RI field investigation activities, the collected data were interpreted to develop a conceptual site model for the CCB-derived constituents in environmental media at the Area of Investigation. The findings of the RI are summarized below.

2.2.1 CCB Visual Inspections

A visual inspection program was developed and conducted as part of the RI. In this program, CCB visual inspections were conducted at over 3,800 "inspection locations" within rights-of-ways (ROWs) and at over 4,600 inspection locations on private property, for a total of over 8,400 inspected locations within the Area of Investigation. The inspection locations evaluated during the visual inspection represent a wide range of areas within the Area of Investigation. Visual inspections began within ROWs. Inspection locations were spaced at 50-foot intervals, and at each inspection location, a 6-inch core was collected using a slotted soil recovery probe. The visual inspection was performed on this core that extended six inches into the subsurface~~.~~ (0 – 6 inches below ground surface (bgs)). Where the extent of suspected CCBs extended beyond ROWs and onto private property, property owners were identified and contacted with requests for access to continue the visual inspections on private property.

The CCB visual inspections were conducted along every road within the Area of Investigation, and extended out into private properties where warranted (and where access was granted). It is clear, based on historical evidence and visual inspection, that CCBs were used as fill only in a subset of the Area of Investigation.

Figure 4 depicts the information compiled about the potential locations of suspected CCBs at the ground surface within the Area of Investigation based on the visual inspections and the information presented in the RI Report (AECOM, 2010). As the figure shows, suspected CCBs are located in discrete areas in the Town of Pines predominantly associated with roadways, and are not distributed throughout all areas. However, the presence or absence of CCBs within the Area of Investigation at locations not otherwise identified as "field verified suspected" or "inferred suspected" CCB locations is not known at this time.

The visual inspection results for private properties where suspected CCBs were located at the surface indicated that the majority of the inspection locations had a suspected CCB content in the 1-25% range, some in the 25-50% range, and only a very few in the 50-75% range. None of the inspection locations were in the 75-100% CCB range.

For the purposes of the HHRA, the results of the CCB visual inspection program were tallied for 43 properties where suspected CCBs were identified at the ground surface. This was done by estimating the percent suspected CCBs present in each "exposure area," where an exposure area is defined as a residential lot or a subset of a residential lot if the lot size was large. In estimating the percent of suspected CCBs present across each exposure area, a conservative approach was taken by using methods that would result in the highest possible estimate of percent suspected CCBs present, as described below. The exposure area was defined for each property as essentially the size of the residential lot, but included the contiguous ROWs because most suspected CCBs within the Area of Investigation are located within the ROWs. In the few instances of a large property where suspected CCBs were located only within a smaller portion of that larger property, the exposure area was identified as approximately the size of a standard residential lot taking care to include the locations where suspected CCBs were identified. This refinement ensured that the large areas of these properties that did not have suspected CCBs at the surface did not “dilute out” the results for the areas where suspected CCBs were present. For each property:

- Each inspection location was plotted and the inspection result (no suspected CCBs, or suspected CCBs present within what classification range) was identified.
- The area where suspected CCBs were identified and the total exposure area were measured.
- For the area on each property where suspected CCBs were identified, the average percent of suspected CCBs present within that area was calculated (using the assumption that at each inspection location, the CCB amount was the maximum within the classification range).
- Then taking into account the size of the total exposure area, the size of the area with suspected CCBs present, and the average percent of suspected CCBs present within that area, the average percent suspected CCBs across the entire exposure area was calculated for each of the 43 properties.

This evaluation is presented in detail in Appendix I of the HHRA Report (AECOM, 2011a), and the results are presented here in Figure 7. This analysis demonstrated that 27% CCBs at the ground surface is the maximum average percent for any of the 43 properties (or exposure areas), and that the majority of the properties are below 15% suspected CCBs with an average of 6% suspected CCBs across all the properties where CCBs were located.

There is some uncertainty associated with the 27% CCB value derived from the visual inspections. However, the samples were classified by trained staff and the classifications were conducted to over-estimate rather than under-estimate the CCB content. The visual inspections identified many properties where CCBs were not present. Only properties where CCBs were present were included in the calculation of the maximum average percent CCBs. Also, for the exposure calculations, each inspection location was assumed to contain the maximum percent in the range of suspected CCBs in which it was classified, that is:

- all inspection locations in the 0-25% range were assumed to consist of 25% CCBs,
- all inspection locations in the 26-50% range were assumed to consist of 50% CCBs,
- all inspection locations in the 51-75% range were assumed to consist of 75% CCBs,
- all surface inspection locations that did not have a percent of suspected CCBs assigned were assumed to consist of 25% CCBs.

Note that there were no inspection locations identified in the 75-100% CCB range.

By including only those properties where the presence of suspected CCBs was identified, and by assuming each inspection location contained the maximum percent of CCBs within the classification range, uncertainty was highly biased toward estimating a high average percent of CCBs. Therefore, the method used to calculate the percent of CCBs present on each property was very conservative. In addition, the maximum calculated value (27%), was then used in evaluating potential risk.

As noted previously, the maximum percent CCBs at any property was calculated as 27%. The 27% value was used in the HHRA under the site-specific scenario~~.~~ for the residential and outdoor worker CCB exposure scenarios. The percent CCBs at the 43 properties surveyed ranged from a low of less than 1% to the maximum 27%. The following summary statistics and median and percentile values were calculated, as well as the 95% upper confidence limit (UCL). The UCL was calculated using ProUCL Version 4.1.01 (Attachment 1 of Attachment A in Appendix B provides the ProUCL output):

Summary statistics	
Minimum average percent CCBs	0.18%
Maximum average percent CCBs	27.38%
Mean average percent CCBs	6.77%
Percentiles of the average percent CCBs	
10th	1.16%
50th (median)	5.19%
90th	14.45%
UCL of average percent CCBs	
95% Approximate Gamma UCL	8.61%

As shown above, the estimates of the upper bound of the percent suspected CCBs are much lower than the maximum average percent used in the HHRA. The 95% UCL calculated by ProUCL is 8.6%, almost one quarter the value used in the HHRA. The 90th percentile of 14.5% is almost half of the value used in the HHRA. The use of the maximum average percent CCBs to represent all the properties reduces the uncertainty, because the majority of properties contain a much lower percent CCBs.

To further demonstrate the conservative nature of the approach, an alternative estimate of the percent of CCBs present in each exposure area was derived, in which the midpoint of the percent within each classification range, instead of the maximum was used, that is:

- ~~all~~All inspection locations in the 0-25% range were assumed to consist of 12.5% CCBs,
- ~~all~~All inspection locations in the 26-50% range were assumed to consist of 37.5% CCBs,
- ~~all~~All inspection locations in the 51-75% range were assumed to consist of 62.5% CCBs,
- ~~all~~All inspection surface locations that did not have a percent of suspected CCBs assigned were assumed to consist of 25% CCBs.

Attachment 2 of Attachment A in Appendix B presents the calculations, which result in a maximum average percent of CCBs across each exposure area of 18%. Therefore, use of the midpoint would have been a reasonable choice in calculating the percent of CCBs present at each location. To reduce uncertainty and provide for a conservative estimation, the maximum was employed.

Summary

In estimating the percent of CCBs present across each exposure area in surficial soils (0 to 6 inches bgs), a conservative approach was taken by using methods that would result in the highest possible estimate, including the following:

- Including in the calculations only those properties on which suspected CCBs were identified;
- Inspecting many locations on each property to identify where suspected CCBs were located;
- Assuming the maximum percent of CCBs in each classification range;

- Using the highest percent CCBs on any property (27%) to represent the percent of CCBs present at all properties in surficial soils, rather than the 95% UCL (8%) or the 90th percentile (15%).

This approach biases all of the calculations toward a higher than actual measure of the percent of CCBs present in surficial soils on residential properties in the Area of Investigation. Using the maximum 27% CCBs in the HHRA for the residential and outdoor worker CCB scenarios provides a conservative estimate of potential exposure and risk in the Area of Investigation. Developing remedial decisions without the use of this critical site-specific information may misguide those decisions. While there is no information as to the percent CCBs in subsurface soils, the majority of potential residential exposure is to surface soils.

The exposure point concentrations (EPCs) used in the HHRA were also developed to provide an upper-bound estimate of risk. The EPCs were based on the 95% UCL on the arithmetic mean of the data from the MWSE sampling. This statistical treatment accounts for a 5% chance that specific sample locations may have a concentration greater than the EPC. The calculation of the 95% UCL, using USEPA's ProUCL software, takes into account the variability in the data, for example, where the data are more variable, the 95% UCL will be higher. Therefore, although there may be some locations where an analytical result may be higher than the 95% UCL, that result is unlikely to represent the average concentration across a given property. As described in USEPA guidance, the reasonable maximum exposure (RME) scenario is not meant to define the absolute maximum of all exposure inputs, but rather reasonable upper bounds. However, it is possible that at a given property there could be higher concentrations and/or higher variability than found in the MWSE data set.

2.2.2 Chemistry of Background Soil

The natural soils in the Area of Investigation include both granular soils (primarily dune sands, but also silts and clays) and organic soils, which may be mixed with granular materials. All of the natural geologic materials contain a wide variety of metals at different concentrations, such as aluminum (Al), arsenic (As), ~~boron (B),~~, barium (Ba), cadmium (Cd), calcium (Ca), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), mercury (Hg), nickel (Ni), potassium (K), sodium (Na), selenium (Se), strontium (Sr), sulfur (S), (uranium) U, vanadium (V), and zinc (Zn). Notably, As was present in all the background soil samples at concentrations above the risk-based comparison level for human health. This is not unexpected, as As is present at concentrations above risk-based comparison levels in most natural soils in the United States. Mn and thallium (Tl) were detected in one background soil sample at concentrations above the human health risk-based comparison level. Levels of the radionuclides Pb-210, radium (Ra)-226, and Ra-228 were also greater than human health comparison levels in most samples. None of these soil samples is significantly affected by CCB-derived constituents; instead, the results reflect the natural and anthropogenic levels of metals and radionuclides in soils in the area. Potential risks associated with background soils were evaluated quantitatively in the risk assessments.

Five of the background samples were analyzed for particulate matter to determine if CCBs~~, and~~ are present in the samples. Three (3) of them were reported to contain trace levels of CCBs. One sample was reported to contain 1% ~~CCBs and two samples were~~bottom ash and a trace amount (<0.25%) fly ash, one sample was reported to contain ~~<1% CCBs~~0.75% bottom ash and a trace amount (<0.25%) fly ash, and one sample was reported to contain <0.25% fly ash. Figure 11 shows the locations of the background samples and the results for the particulate matter analysis. To evaluate the potential impact of using background samples which may contain up to 1% CCBs, the background EPCs were adjusted downwards in a sensitivity analysis to subtract out the concentration potentially associated with 1% CCBs. The background EPCs with the 1% CCBs subtracted were then used to re-calculate the potential background risks and hazards using the same methods as used in the HHRA. The potential risk and hazard estimates are only very slightly lower than those estimated in the HHRA. Therefore, the inclusion of background samples that may contain up to 1% CCBs has virtually no influence on the comparison between potential risks associated with suspected CCBs and background soils. The details of this evaluation are presented in Attachment B of Appendix B.

2.2.3 Chemistry of Suspected CCBs

A total of 34 suspected CCB samples were collected from 34 utility trench locations during the MWSE installation, and analyzed for metals and inorganics. Most of the metals present in suspected CCBs are also present in background soils, although concentrations for some are higher in suspected CCBs. The As concentrations in all the suspected CCB samples were above the risk-based comparison level as were all of the As concentrations in all the background soils. Iron was also present in many suspected CCB samples at concentrations above the risk-based comparison level for human health. Hexavalent Cr was detected and above the human health risk-based comparison level in all of the suspected CCB samples in which it was analyzed. However, it should be noted that the validity of the draft toxicity value upon which the comparison level is based has been questioned by USEPA's Science Advisory Board (SAB). The SAB review can be accessed at http://cfpub.epa.gov/ncea/iris_drafts/recordisplay.cfm?deid=221433. A finalized value is not yet available.

To evaluate radionuclides in suspected CCBs, a subset of 10 of the samples collected during the MWSE installation were analyzed using approved analytical methods. Data collection for the purposes of the human health risk assessment focused on radiological analysis of discrete CCB samples. In addition, 10 samples collected from the Type III (South) Area of Yard 520 were also analyzed for radionuclides.

Potential risks associated with suspected CCBs were evaluated quantitatively in the risk assessments.

2.2.4 Chemistry of Groundwater

The natural background groundwater in the Area of Investigation includes many minerals, typical of most natural fresh waters in the world. These include major ions such as Ca, Mg, Na, silicon (Si), bicarbonate (HCO_3), sulfate (SO_4), and chlorine (Cl), and minor and trace elements such as Al, Ba, B, Mn, Sr, and nitrate (NO_3). Based on RI sampling, background concentrations of B in the surficial aquifer in the Area of Investigation range up to 0.119 milligrams per liter (mg/~~l~~L); Mo up to 0.012 mg/~~l~~L. The USGS has documented that natural levels of B in the deeper confined aquifers can be expected to be above both the USEPA's RAL of 0.900 mg/~~l~~L and the human health risk-based comparison level of 0.730 mg/~~l~~L.

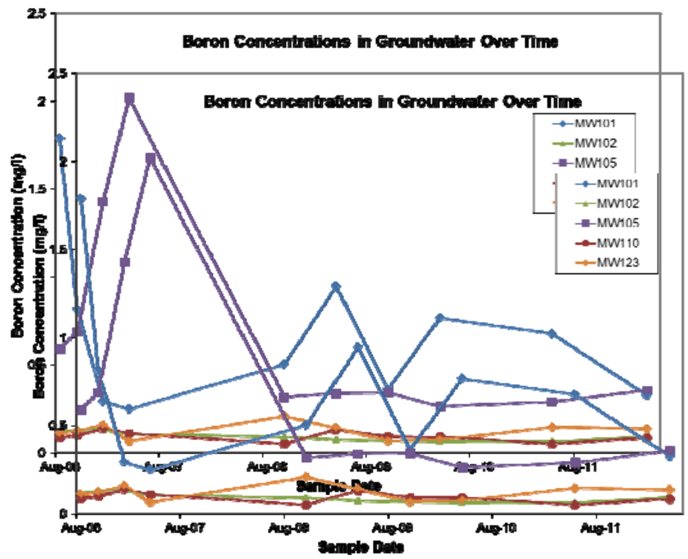
Based on the RI data, CCB-derived constituents in groundwater include B, SO_4, Ca, Mg, Sr, and Mo. As also appears to migrate from CCBs to groundwater, at least at Yard 520, but it is not transported any significant distance with the groundwater. Fe and Mn may also have the potential to migrate from CCBs to groundwater, but their mobility in groundwater is controlled by redox conditions. Of these, the RI Report indicated that B, Mo, SO_4, As, Fe, and Mn were present in at least one groundwater sample at concentrations above human health risk-based comparison levels. Other constituents detected at least once at concentrations above comparison levels included Se, Cl, and NO_3, but these are not likely to be CCB-derived.

Migration from CCBs to groundwater appears to occur where large volumes of CCBs are present, such as at Yard 520 and areas where suspected CCBs extend significantly beyond roadways. The relationship between the presence of suspected CCBs and boron in groundwater is shown on Figure 8. It is uncertain whether migration from CCBs to groundwater occurs where CCBs are used only as road sub-base, as constituent concentrations are generally low in these areas (see below). In at least one monitoring well location (MW111), elevated CCBs occur in an area of known road sub-base and underlying road fill combined (five feet of thickness as documented in the boring log for MW111). Possible larger accumulations of CCBs nearby (i.e., to the east of Illinois Avenue) may also contribute to concentrations in groundwater, as well as areas located around test pit TP026 (greater than four and a half feet of CCB fill) and TP027 (greater than seven feet of CCB fill), which are located upgradient of MW111. Several wells are located in or downgradient from areas where suspected CCBs are present only as road sub-base, including MW107, MW108, MW114, and PW005, as shown on Figure 9. These wells do not show the presence of elevated levels of boron. In addition to the smaller amounts of suspected CCBs present, the paving of roadways may reduce groundwater recharge and migration of CCB-related constituents to groundwater.

The RI has documented the extent of CCB-derived constituents in groundwater. Concentrations of B, SO_4, Ca, Mg, Sr, and Mo are elevated at and downgradient from Yard 520. To the east, elevated concentrations of these constituents are present in the vicinity of areas where suspected CCBs may have been used as fill (that is, they are present beyond the roadways), and downgradient to the south as far as the East Branch of Brown Ditch. Hydraulic gradients indicate that all groundwater containing CCB-derived constituents flows towards and into the Brown Ditch system, including its related tributaries and wetlands. The interpreted extent of elevated boron in groundwater is shown on Figure 9.

In addition, groundwater from Yard 520 flows into Brown Ditch and its related tributaries and wetlands in the immediate vicinity of Yard 520, and the hydrogeologic studies performed as part of the RI have demonstrated that groundwater does not flow from Yard 520 to the south beneath Brown Ditch. Also, based on the available information, CCB-derived constituents in groundwater do not extend northward into IDNL at levels of significance. CCB-derived constituents in groundwater do not currently appear to extend to areas where private water wells are located outside the area currently supplied by municipal drinking water.

In addition to CCB-derived constituents in groundwater, the groundwater in the surficial aquifer beneath the Area of Investigation shows evidence of other sources of impact, including septic system discharges, road salt, and the Pines Landfill (owned by Waste Management). Elevated concentrations of a number of non-CCB-derived constituents, such as Na, Cl, NO_3, ammonia (NH_4), and bacteriological parameters, were detected in many samples. Groundwater directly south of Yard 520 and Brown Ditch appears to be impacted by a landfill to the south (Pines Landfill, owned by Waste Management). Concentrations of B in monitoring wells in this area are most likely a result of landfill contaminants. Fe and Mn are elevated in a number of wells, including from one background well (MW113), un-related to CCBs. Natural levels of Fe and Mn are common in groundwater in many areas of the country, including in northern Indiana, and are commonly the cause of unpleasant taste and appearance of well water.



Since completion of the RI sampling, the Respondents have continued to sample a subset of monitoring wells. The purpose of this sampling is to identify whether CCB-derived constituents in groundwater are migrating ~~further~~farther northward ~~(that is, in a new direction).~~. The additional monitoring conducted during the four years after the RI was completed has shown that the extent of CCB-derived constituents in groundwater has not expanded northward. Furthermore, concentrations have decreased in some of the wells, as shown on the graph to the right, indicating that the extent of the CCB-derived constituents has decreased. Concentrations at MW101 and MW105 have decreased significantly since their maximum concentrations measured during the RI. MW110 and MW123 are the northernmost wells, located north of West Dunes Highway and upgradient from IDNL. The concentration of B in these wells has consistently remained low, indicating that CCB-related constituents do not extend to IDNL, nor is there any indication they are currently migrating towards INDL. The post-RI groundwater data are included in Attachment C of Appendix B. All results from these wells are below the ~~tapwater~~tap water Regional Screening Level (RSL) for B.

In addition to sampling selected wells, the Respondents continue to measure water levels at all wells and surface water monitoring locations. Groundwater levels fluctuate slightly on a seasonal basis, generally being higher in the winter and spring and lower in the summer and fall (growing season). Overall, there has been no significant change in groundwater levels or hydraulic gradients since the completion of the RI field work. Because gradients have not changed, it is unlikely that constituents in groundwater would migrate in different directions, that is, it is unlikely that CCB-derived constituents would migrate to areas where they were not present during the RI.

2.2.5 Chemistry of Surface Water

The upgradient (background) surface water contained measurable levels of metals and other constituents. The presence of these naturally occurring constituents in the surface water samples is not unexpected and, in many cases, can be attributed to weathering and erosion of local soils, sediments, and geologic formations as well as anthropogenic influences such as agricultural practices and run-off from roadways and railroads. The dissolved oxygen (DO) concentrations in upgradient locations were relatively low, especially in the summer and early fall, such that Brown Ditch would not support a coldwater fishery, and even warmwater fish may be seasonally stressed in some locations.

The RI Report indicated that, in upgradient surface water, concentrations of Al, Fe, Mn, and V were above the associated ecological comparison level in one or more samples. The concentration of Mn was above the human health comparison level in one sample, and this was the only surface water sample with a constituent present at a level above a human health comparison level. The presence of

Al in surface water is associated with suspended solids in the water, as measured by Total Suspended Solids (TSS). Total Fe and Mn concentrations also are likely to be a function of the amount of particulate matter in the samples. Dissolved Fe and Mn can be associated with low DO and associated redox conditions.

The Brown Ditch surface waters (that is, within the Area of Investigation, downgradient of the upgradient locations) also contained measurable levels of metals and other constituents. As with the upgradient locations, the presence of these naturally occurring constituents in the surface water samples is not unexpected and, in many cases, can be attributed to weathering and erosion of local soils, sediments, and geologic formations. However, concentrations of several metals were higher than in upgradient samples.

The RI Report indicated that concentrations of B in surface water were above the human health and ecological comparison levels in certain samples in the West, East, and Main Branches of Brown Ditch. Typically, higher concentrations were measured in the summer (dry period). In the West Branch, some of these samples also have Mo concentrations above the human health risk-based comparison level but not the ecological comparison level. These elevated concentrations of B and Mo are most likely due to the contribution of groundwater containing CCB-derived constituents to the ditches.

Concentrations of Al were above its ecological comparison level in many surface water samples, both at upgradient and Brown Ditch locations. The Al appears to be associated with sediment and suspended particles in the samples as measured by the TSS. Al concentrations are generally higher in upgradient samples.

Concentrations of Fe and Mn were above the associated ecological comparison levels in many upgradient and Brown Ditch sample locations but only one Brown Ditch sample of Fe was above the human health comparison level. The total fraction of these constituents may also be associated with suspended sediment in the samples; the dissolved fraction may be associated with locally low levels of DO in some segments of the ditches.

2.2.6 Chemistry of Sediments

In upgradient (background) locations, sediment samples are typically sandy with low levels of organic material. Boron was not detected in any upgradient sediment samples; however, the detection limit for B in sediments was elevated for all samples analyzed. Pb, Se, and Ba were above the ecological comparison levels in upgradient sediment samples, and As concentrations were above the human health comparison level. The presence of these metals in background sediments shows that sediments outside of areas that could be affected by CCB-derived constituents contain concentrations of some metals that are above risk-based comparison levels.

The sediments in Brown Ditch (that is, at locations within the Area of Investigation, downgradient of the upgradient locations) included both sandy and highly organic sediments. In contrast with the upgradient samples, the majority of the Brown Ditch samples contained greater than 1% total organic carbon (TOC). The percentage of fine-grained material (silts and clays) was also generally higher in downgradient samples. These differences reflect differences in the depositional environments between upgradient and Brown Ditch locations.

The Brown Ditch sediments contained metals and other constituents. The presence of these naturally occurring constituents in the sediment samples is not unexpected and, in some cases, can be attributed to weathering and erosion of local soils, sediments, and geologic formations. Boron was detected in two sediment samples from Brown Ditch, SW022 and SW026; however, as noted above, the detection limit for B in sediments was elevated for all samples analyzed. Based on their locations and B concentrations, B in these sediments is likely associated with groundwater containing CCB-derived constituents. There are no ecological risk-based comparison levels for B in sediment. The concentrations are below the human health risk-based comparison level.

In general, concentrations of many metals in the Brown Ditch sediments were greater than concentrations at upgradient locations, consistent with the finer-grained and more organic nature of many of the Brown Ditch system sediment samples. Concentrations of As, Ba, Cu, Fe, Pb, Mn, Ni, Se, V, and Zn in the Brown Ditch sediments for some locations were above associated ecological risk-based comparison levels. Results for Al, Cd, or Cr in Brown Ditch sediments were below associated ecological risk-based comparison levels. All detected concentrations of As in the Brown Ditch sediments, some detected concentrations of Fe, and one detected Tl concentration are above human health risk-based comparison levels.

The interpretation of some metals in Brown Ditch sediments may be confounded by the higher percentage of fines, higher TOC concentrations, lower percent solids, and presence of other potential sources in Brown Ditch sediments compared to upgradient sediments, but the concentrations of some metals are clearly elevated in samples located in proximity to significant CCB sources. When the percentage of fines is taken into account, concentrations of most metals (except for soluble CCB-related constituents such as B and Mo) are similar to upgradient concentrations and there is no consistent spatial pattern that can be attributed to CCB-derived constituents. A formal statistical comparison to upgradient concentrations was conducted as part of the Risk Assessments.

2.2.7 Fate and Transport

Constituents present in environmental media will be affected by various attenuation processes as they migrate that will tend to reduce their concentrations. In groundwater, B, SO_4, Ca, Mg, and Sr are highly soluble and not very chemically reactive. Therefore, they are less likely to participate in chemical reactions that remove them from groundwater. They will typically be transported downgradient with the groundwater flow, with concentrations reduced primarily through dispersion. These constituents will then enter surface water in the Brown Ditch system with the groundwater. The fate and transport of Mo is similar, except that it appears to be subject to some additional attenuation processes, at least locally.

The fate and transport of Fe, Mn, and As in groundwater are controlled by redox conditions. Where groundwater is oxidized, these constituents will form insoluble molecules and will be removed from the groundwater system. Where groundwater is reduced, these molecules will dissociate and release the constituents into the groundwater. This process occurs with naturally-occurring Fe, Mn, and As in the native soils in the Area of Investigation as well as any Fe, Mn or As that might migrate from CCBs. Reducing conditions in groundwater are present locally throughout the Area of Investigation, most likely caused by organic inputs to the groundwater, such as septic system discharges, wetlands and highly organic soils, former gasoline stations, and the Pines Landfill (owned by Waste Management). Where such reducing conditions are present near the Brown Ditch system, including its associated wetlands, these constituents could be mobile and enter the ditch with the groundwater. Where groundwater near the ditches is oxidized, Fe, Mn and As will not be mobile and, therefore, will not migrate into surface water.

In surface water, constituent concentrations tend to decrease with distance downstream from sources due to mixing and dilution. When constituents partition from the ~~porewater~~pore water into the sediments, they are less available to interact with ecological receptors. Uptake of nutrients by plant life can reduce concentrations in sediment and surface water. Biological processes in general can transform constituents and affect their fate and mobility (e.g., denitrification). In addition, the potential ecological effects of some constituents in surface water can be hardness dependent. CCB-derived constituents are not considered bioaccumulative.

2.3 HHRA

The HHRA was conducted as part of the RI/FS process in order to evaluate the potential risks to human receptors posed by CCB-derived constituents in environmental media within the Area of Investigation. A baseline HHRA was conducted for the Area of Investigation in accordance with the four-step paradigm for human health risk assessments developed by USEPA (USEPA, 1989a): 1) Hazard Identification, 2) Dose-Response Assessment, 3) Exposure Assessment, and 4) Risk Characterization. A summary of each step is presented below, followed by results and conclusions.

2.3.1 Hazard Identification

The purpose of the hazard identification process is two-fold: 1) to evaluate the nature and the extent of release of CCB-derived constituents present within the Area of Investigation; and 2) to identify a subset of these constituents as constituents of potential concern (COPCs) for quantitative evaluation in the risk assessment.

COPCs were identified using a series of screening steps, including frequency of detection, comparison of maximum detected concentration to screening levels, comparison to background, and essential nutrient status.

The following COPCs were designated for quantitative evaluation in the HHRA[1]:

> Chemical Constituents: Al, As, B, Cr (VI) (hexavalent chromium), cobalt (Co), Fe, Mn, Mo, Se, Sr, Tl, and V.
>
> Radionuclides: Detected radionuclides were grouped according to their decay series and selected as COPCs using the "+D" or "+daughters" designation and slope factors as appropriate. Polonium (Po)-210 was detected but is included as a COPC as part of the Pb-210 decay chain and was not included as a separate radionuclide in the calculations. Radionuclides selected as COPCs include: U-238+D, U-234, Thorium (Th)-230, Ra-226+D, Pb-210+D, U-235+D, Th-232, Ra-228+D, and Th-228.

2.3.2 Dose-Response Assessment

The purpose of the dose-response assessment is to identify the types of adverse health effects a constituent may potentially cause, and to define the relationship between the dose of a constituent and the likelihood or magnitude of an adverse effect (response) (USEPA, 1989a). Adverse effects are classified by USEPA as potentially carcinogenic or noncarcinogenic (i.e., potential effects other than cancer). Dose-response relationships are defined by USEPA for oral and inhalation exposures. Oral toxicity values are also used to assess dermal exposures, with appropriate adjustments, because USEPA has not yet developed values for this route of exposure (USEPA, 1989a). The USEPA's

[1] Note that not all constituents are COPCs in all media.

guidance regarding the hierarchy of sources of human health dose-response values in risk assessment was followed (USEPA, 2003) for chemical constituents; sources of the published dose-response values used in the HHRA are further detailed in that report.

2.3.3 Exposure Assessment

The purpose of the exposure assessment is to predict the magnitude and frequency of potential human exposure to each of the COPCs retained for quantitative evaluation in the HHRA. First, potential exposure pathways are identified, then EPCs for each COPC are determined.

Exposure pathways and receptors were evaluated and selected in the HHRA based on the location of source areas, potential migration pathways of constituents from source areas to environmental media where exposure can occur, and current and future site uses. Ultimately, three general groups of receptors were evaluated in the HHRA:

- Residential receptors: Residential receptors were assumed to be potentially exposed to COPCs in suspected CCBs via incidental ingestion, dermal contact, inhalation of dusts, and via external exposure to gamma radiation. The residential child was also assumed to wade or swim in a local water body, was assumed to be potentially exposed to surface water via dermal contact (and via incidental ingestion for the swimming scenario) and sediment via incidental ingestion and dermal contact, and ingest fish. The residential child was also assumed to be potentially exposed to radionuclides in Brown Ditch sediment via incidental ingestion and external exposure. In a hypothetical screening level scenario, it was conservatively assumed that the receptor's entire residential exposure area is comprised of CCBs and that all contact that would normally be assumed to occur with soils would occur with CCBs – this is a hypothetical scenario that has been shown to not be representative or even exist within the Area of Investigation by the extensive CCB visual inspection program conducted as part of the RI (refer to previous discussion). As presented in the HHRA (and discussed above), the percent of suspected CCBs at the ground surface at each residential property was calculated, with values ranging from a low of less than 1% CCBs to a maximum estimated 27%. Therefore, a second site-specific scenario (i.e., using a site-specific maximum 27% CCB scenario) was evaluated in the HHRA. Assuming gardens are present within areas containing suspected CCBs, residential adults and children may potentially be exposed to COPCs in produce. Where groundwater is used as a source of drinking water (i.e., outside the area that has been supplied municipal water), residents may be exposed to CCB-derived constituents that may have migrated into groundwater. The drinking water pathway is only potentially complete for those residents who use groundwater from the surficial aquifer as a drinking water source.

- Recreational receptors were assumed to be potentially exposed to COPCs in suspected CCBs in dust via inhalation, and to COPCs via dermal contact with surface water while wading or swimming in a local water body, via incidental ingestion and dermal contact with sediment while wading or swimming, and via ingestion of fish caught in a local water body. Both the recreational fisher and the recreational child were assumed to ingest fish. The recreational receptors were also assumed to be potentially exposed radionuclides in Brown Ditch sediment via incidental ingestion and external exposure.

- Industrial receptors (construction workers and outdoor workers) were assumed to be exposed to suspected CCBs via incidental ingestion, dermal contact, inhalation of dusts, and external exposure to gamma radiation. The construction worker was also assumed to be potentially exposed to COPCs in groundwater during excavation. The outdoor worker is assumed to be exposed to materials at the ground surface and, therefore, both the hypothetical screening level 100% CCB and the site-specific 27% CCB scenarios are evaluated for this receptor. The construction worker scenario conservatively assumes that all excavations occur through suspected CCBs, thus only the 100% CCB scenario was evaluated for this receptor.

~~(~~RME scenarios~~,~~ and central tendency exposure (CTE) scenarios based on appropriate USEPA guidance were both evaluated in the quantitative risk assessment. Each of the scenarios evaluated represent conservative exposure assumptions that are more likely to over-estimate than under-estimate risk. For example, a residential child of 0-6 years of age is assumed to wade in Brown Ditch 26 days per year for 2 hours each day for a total of 52 hours each year, to consume 13 meals of fish caught from Brown Ditch each year, and to contact and ingest CCBs and inhale CCB-derive dusts from a residential yard 250 days per year, among other assumed exposures.

EPCs for media being evaluated in the HHRA were derived from measured data. Where possible, EPCs were the lower of the maximum detected concentration and the 95% UCL, per USEPA guidance. Where too few data points were available to calculate the 95% UCL, the maximum detected concentration was selected as the EPC. EPCs for fugitive and excavation dusts were calculated from suspected CCB or soil concentrations based on USEPA models. Fish tissue concentrations were derived from surface water concentrations using water-to-fish uptake factors.

The data used in the HHRA were from the MWSE sample locations along roadways that are adjacent to residential properties. Where the road sub-base extends onto yards and properties, the MWSE data can be assumed to be representative of the suspected CCBs identified on those properties. Where larger areas were filled beyond the road sub-base, available information (such as aerial photograph, town records, NIPSCO records) indicates this material is expected to have the same chemical composition as the material used in the roads. This is discussed in more detail in the HHRA. The EPCs were based on the 95% UCL on the arithmetic mean of the 34-point dataset from the MWSE sampling. This statistical treatment accounts for a 5% chance that specific sample locations may have a concentration greater than the EPC. The calculation of the 95% UCL, using USEPA's ProUCL software, takes into account the variability in the data. In instances where data are more variable, the 95% UCL will be higher. Therefore, although there may be some location where an analytical result may be higher than the 95% UCL, that result is unlikely to represent the average concentration across a given property. As described in USEPA guidance, the RME scenario is not meant to define the absolute maximum of all exposure inputs, but rather reasonable upper bounds. However, it is possible that at a given property there could be higher concentrations and/or higher variability than found in the MWSE data set.

2.3.4 Risk Characterization

The potential risk to human health associated with potential exposure to COPCs in environmental media in the Area of Investigation was evaluated in this step of the risk assessment process. Risk characterization is the process in which the dose-response information is integrated with quantitative estimates of human exposure derived in the Exposure Assessment. The result is a quantitative estimate of the likelihood that humans will experience any adverse health effects given the exposure assumptions made.

The potential carcinogenic risk for each exposure pathway was calculated for each receptor. In current regulatory risk assessment, it is assumed that carcinogenic risks are cumulative. Pathway and area-specific risks are summed to estimate the total potential carcinogenic risk for each receptor.

The total potential carcinogenic risks for each receptor group are compared to the USEPA's target risk range of 10^{-4} to 10^{-6}. A COPC that poses a risk within or above the USEPA target risk range of 10^{-4} to 10^{-6} for a particular receptor is designated a constituent of concern (COC). The target risk levels used for the identification of COCs are based on USEPA guidance and were identified in the approved HHRA Work Plan (ENSR, 2005b). Specifically, USEPA provides the following guidance (USEPA, 1991b):

> "EPA uses the general 10(-4) to 10(-6) risk range as a "target range" within which the Agency strives to manage risks as part of a Superfund cleanup. Once a decision has been made to make an action, the Agency has expressed a preference for cleanups achieving the more protective end of the range (i.e., 10(-6)), although waste management strategies achieving reductions in site risks anywhere within the risk range may be deemed acceptable by the EPA risk manager. Furthermore, the upper boundary of the risk range is not a discrete line at 1 x 10(-4), although EPA generally uses 1 x 10(-4) in making risk management decisions. A specific risk estimate around 10(-4) may be considered acceptable if justified based on site-specific conditions, including any remaining uncertainties on the nature and extent of contamination and associated risks. Therefore, in certain cases EPA may consider risk estimates slightly greater than 1 x 10(-4) to be protective."

And

> "Where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 10^{-4}, and the non-carcinogenic hazard quotient is less than 1, action generally is not warranted unless there are adverse environmental impacts."

In addition, IDEM offers the following guidance regarding target risk level:

> "The Indiana Risk Integrated System of Closure (RISC) [IDEM. 2001. Risk Integrated System of Closure Technical Guide. February 15, 2001.], and the latest IDEM guidance [IDEM. 2012. Remediation Closure Guide. March 22, 2012. http://www.in.gov/idem/6683.htm] uses the target risk range of 1E-06 to 1E-04. The IDEM residential soil screening levels are set at a 1E-05 target risk level [see Appendix A of IDEM, 2012]. Section 7.6 of the IDEM guidance document states: "The cumulative hazard index of chemicals that affect the same target organ should not exceed 1, and the cumulative target risk of chemicals that exhibit the same mode of action should not exceed 10^{-4}. U.S. EPA risk assessment guidance views these criteria as "points of departure", and IDEM will generally require some further action at sites where these risks are exceeded. Further action may include remediation, risk management, or a demonstration utilizing appropriate lines of evidence that the risk characterization overstates the actual risk."

The potential for exposure to a constituent to result in adverse noncarcinogenic health effects is estimated for each receptor by comparing the dose for each COPC with the reference dose (RfD) for that COPC. The resulting ratio, which is unitless, is known as the hazard quotient (HQ) for that constituent. The target HQ is defined as an HQ of less than or equal to one (USEPA, 1989a). When the HQ is less than or equal to 1, the RfD has not been exceeded, and no adverse noncarcinogenic effects are expected. If the HQ is greater than 1, there may be a potential for adverse noncarcinogenic health effects to occur; however, the magnitude of the HQ cannot be directly equated to a probability or effect level. HQs for a given pathway are summed to provide a hazard index (HI). Pathway HIs are summed to provide a total receptor HI. When the HI is less than 1, the target has not been exceeded, and no adverse noncarcinogenic effects are expected. This initial HI summation assumes that all the COPCs are additive in their toxicity, and is considered only a screening step because additive toxicity may not occur. If the HI is greater than 1, further evaluation is necessary to determine if the COPCs are additive in toxicity. This evaluation is termed a target endpoint analysis. COPCs that cause an exceedance of a target-endpoint specific HI of 1 are designated COCs.

The HHRA results are discussed below and summarized in Table 1 for the non-drinking water exposure scenarios, and in Table 2 for the drinking water scenario evaluation. For the purposes of this memorandum, the discussion and the results in the tables focus on the RME scenario.

2.3.4.1 Results of Chemical and Radiological Risk Assessment – Non-Drinking Water Pathways

The results of the chemical and radiological risk assessment are presented in Table 1 for the non-drinking water pathways. Based on the discussion in Section 2.2.1 above, results shown in Figure 7, and based on the detailed discussion in the HHRA Report, the 27% CCB exposure scenario for the residential receptor and the outdoor worker is site-specific and it represents an RME scenario. Therefore, the hypothetical screening-level 100% CCB scenario results are presented in Table 1 for context, but the discussion below focuses on the results of the 27% CCB scenario evaluation~~.~~ — for the residential receptor and the outdoor worker. The 27% CCB scenario is applicable only to residential and outdoor worker potential exposures to CCBs. Construction workers were assumed to contact 100% CCBs, and recreational receptors were assumed to breathe dusts derived from 100% CCBs. Surface water, sediment, and fish tissue exposures for both recreational and residential receptors are unrelated to the %CCB exposure scenario. Therefore, construction worker and recreational receptor potential risks and hazards are presented under the 100% CCB scenario. Potential risks and hazards for residential and outdoor worker receptors are presented under both scenarios. However, it should be noted that since potential risks and hazards for the residential receptor for surface water, sediment, and fish tissue are unrelated to the %CCB exposure scenario, they are the same under both the 27% and the 100% scenarios.

Summary of Potential Background Risks

Background data were evaluated in the HHRA for the residential scenario. Potential carcinogenic risks were within the 10^{-4} to 10^{-6} range.

Further, the HQ for Tl for the background dataset is greater than the noncarcinogenic ~~regulatory~~ target hazard index of one. As discussed in greater detail in the HHRA Report, the endpoint for Tl is hair follicle atrophy, and the provisional toxicity value provided by USEPA is not necessarily recommended for use. All other target endpoint HQs for background soil are below one.

Summary of Constituent Specific Risk Results

No potential risks greater than 10^{-4} were identified in the chemical HHRA for any of the receptor scenarios evaluated. Potential carcinogenic risks within the 10^{-4} to 10^{-6} target risk range (i.e., greater than 10^{-5} and/or greater than or equal to 10^{-6}) were identified for some, but not all, site-specific 27% CCB RME pathways and scenarios, while no constituents with potential risks greater than or equal to 10^{-5} were identified under the site-specific 27% CCB CTE scenario. ~~In addition, carcinogenic regulatory targets~~Potential risks greater than 10^{-6} were not ~~exceeded~~identified for ~~any of the RME or CTE site-specific 27% CCB scenarios, sediment or surface water scenarios, or~~ the construction worker ~~contact with groundwater~~ under RME or CTE scenarios. Potential risks greater than 10^{-6} but less than 10^{-5} were identified for the recreational child and the recreational fisher sediment scenarios (and these components of the residential scenario). Potential risks greater than 10^{-6} were not identified for surface water or fish ingestion. Based on USEPA's request, COCs have been identified as those constituents with risks greater than 10^{-6} and/or a target endpoint HI of one. These are shown on Tables 1 and 2.

~~Noncarcinogenic regulatory targets were~~A hazard index of one was not exceeded for any of the site-specific 27% CCB scenarios, sediment or surface water scenarios, or construction worker contact with groundwater scenarios. Therefore, no COCs have been identified for noncarcinogenic effects.

Potential exposures and risk via the homegrown produce consumption pathway are within the low end of the range of exposure and risk for the normal background dietary ingestion of arsenic, indicating that potential carcinogenic risk from ingesting homegrown produce containing arsenic is likely not a human health concern.

Comparison of Risks for Background and CCB Scenarios

Although As in suspected CCBs was not found consistent with background, the potential risk from As in background soils is of the same order of magnitude as the potential risk from As in suspected CCBs. Potential risks for the RME resident for As from suspected CCBs are 1×10^{-5} (site-specific 27% CCB scenario), and 2×10^{-5} from background soils.

In addition, the potential residential RME risk from radionuclides in background soils is of the same order of magnitude as the potential residential RME risk from radionuclides in suspected CCBs. Potential risks for the RME resident garden scenario are 4×10^{-5} (site-specific 27% CCB scenario), and 2×10^{-5} for background soils.

As discussed in the USEPA-approved HHRA Report (Section 6.5.3.2), historical information indicates that the suspected CCBs present in residential lots are expected to be the same as CCBs encountered in rights-of-way (and sampled under the MWSE SAP). Thus the MWSE sample results provide a robust data set that is a reasonably conservative representation of suspected CCBs within the Area of Investigation. As such, the MWSE sample data and related HHRA results provide a starting point for risk management decisions and provide a good overall representation of residential exposure conditions across the Area of Investigation.

Evaluation of Regulatory Standards for Radionuclides

In addition to the radionuclide risk assessment, the HHRA included an evaluation of data with respect to regulatory standards for radionuclides. USEPA guidance[2] identifies a standard of 5 picoCuries per gram (pCi/g) above background that is used to assess the combined levels of Ra-226 and Ra-228. The background soil data collected during the RI were used to statistically derive a background threshold value (BTV) for the sum of the Ra isotopes, which ranged from 1 to 2 pCi/g; therefore, the resulting 5 pCi/g plus background range is 6 to 7 pCi/g. As shown in HHRA, all of the results from the suspected CCB dataset, the Brown Ditch sediment dataset, and the upgradient sediment dataset are below this 5 pCi/g plus background range.

[2] 40 CFR 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings." at 40 CFR §192.12.

2.3.4.2 Results of Drinking Water Risk Assessment

The evaluation of the drinking water pathway was conducted in two parts. First, a cumulative screen was used to identify constituents above ~~regulatory targets~~10^{-6} or a hazard index of one in each well for which RI data were collected. Second, data for wells located outside of the municipal water service area was evaluated to determine if those wells were impacted by CCB-derived constituents. This analysis is summarized in Table 2.

Cumulative Risk Screen

The HHRA included a cumulative risk screen to evaluate the residential drinking water pathway. The screen used the RSLs for residential tap water (USEPA, 2011) and, therefore, is protective of other potential drinking water exposure scenarios (e.g., a visitor to the area). The RSLs incorporate agency default, conservative exposure assumptions as well as agency selected toxicity values. Thus, the potential risks and hazards estimated using the RSLs are conservative and are likely overestimates of potential risks and hazards. Analytical data for private wells and RI monitoring wells were compared to RSLs using this cumulative screening approach. A cumulative screen is in essence a risk assessment in which potential risks and hazards are calculated based on the default screening levels.

No constituents with risks greater than 10^{-6} or a total endpoint-specific HI greater than one were identified in any private well. No constituents with risks greater than 10^{-4} or a total endpoint-specific HI greater than one were identified in any background well, although arsenic was identified in background well MW120 with a potential risk greater than 10^{-5}.

Within the MWSE area, constituents with risks greater than 10^{-4} or a total endpoint specific HI greater than 1 were identified only in monitoring wells in the immediate vicinity of Yard 520 (MW-3, MW-6, MW-8, MW-10, TW-12, TW-15D, TW-16D, and TW-18D). Potential risks above 10^{-5} were identified for arsenic in MW104, within the MWSE area; however, the chemistry of this well indicates septic impacts.

Outside of the MWSE area, constituents with potential risks greater than 10^{-4} and a ~~total~~target endpoint specific HI greater than one were identified only for MW111 and MW122, which are in the wetland areas bordering Brown Ditch and downgradient of significant deposits of CCBs or suspected CCBs. Figure 10 presents these results.

Evaluation of CCB-Derived Constituents

The objective of the RI was to evaluate CCB-derived constituents. As such, the drinking water pathway would not be complete if wells are not likely impacted by CCBs, or for which COPCs are not identified. An analysis was conducted to determine whether wells outside the MWSE area are potentially impacted by CCBs. Based on that analysis, although the presence of CCB-derived constituents cannot be entirely ruled out for some wells outside of the MWSE area, the fact that the concentrations of constituents that may be CCB-derived are so low as to not be identified as COPCs suggests that if this pathway is complete, it is insignificant. Therefore, the drinking water pathway for exposure to CCB-derived constituents in the area outside the municipal water service area is likely incomplete, with the exception of MW111 and MW122~~.~~, where total potential risks exceeded 10^{-4} and the total potential hazard index exceeded one. These two wells are located in wetland areas that are unlikely to be developed, though such development in the future cannot be precluded. However, ~~they~~MW111 and MW122 are in areas that could easily be provided municipal water if developed in the future~~.~~ to avoid the potentially unacceptable risks identified in the HHRA.

Similarly, the drinking water pathway within the area of the municipal water service would potentially be complete only where locations have not been connected to municipal water and where wells are screened in the shallow surficial aquifer, and only in those areas in the immediate vicinity of Yard 520 where COPCs have been identified. Thus, this evaluation of the drinking water pathway indicates that CCB-derived constituents in groundwater used as drinking water outside of the immediate vicinity of Yard 520, whether within or outside of the municipal water service area would not be expected to pose a health risk to residents.

Future Scenario for the Groundwater Pathway

Review of the groundwater elevation contours and the constituent data over the course of the RI, as presented in the RI Report, indicates that the constituent distribution in groundwater is largely controlled by the groundwater elevations and location relative to Brown Ditch, and there is no indication of dramatic changes in the elevations across the seasons sampled during the RI. Based on the information provided here in Section 2.2.4 and in the RI Report, groundwater flow and groundwater chemistry are not expected to change significantly in the future in the absence of major unforeseen changes. While not required under AOC II, the Respondents voluntarily continued collecting groundwater data since 2007. Five rounds of groundwater and surface water level measurements and sampling have been conducted since then. These data are used to track the extent of elevated B in groundwater and the results demonstrate that the extent of the B is not expanding northward, and in some wells concentrations have decreased (see discussion in Section 2.2.4).

Therefore, while the groundwater data used in the HHRA are representative of the time period over which it was collected, there is no information that would suggest that these conditions would change dramatically in the future, though this was identified as a source of uncertainty in the risk assessment.

Other Potential Impacts on Groundwater Quality

The results of the extensive RI and this HHRA have shown CCB impacts to groundwater above health risk-based screening levels only in localized areas, either in the immediate vicinity of Yard 520 or in limited wetland areas, and that there are a number of other non-CCB-derived constituents present in groundwater in the area, either due to natural or background conditions, or due to other anthropogenic activities.

There are many possible reasons unrelated to CCBs for water to be unpleasant. One of the most common is natural levels of Fe and Mn which are frequently present in groundwater. Naturally occurring levels of Fe and Mn can discolor household items including silverware, laundry, and jewelry, and can clog filters or well points. The presence of B and/or Mo in groundwater is unlikely to impart a taste or color to the water or cause these kinds of problems.

In addition to high levels of Fe and Mn, the RI revealed evidence of other sources of impacts to groundwater in the area that could make water unpleasant, including:

- Septic system discharges;
- Use of road salt in the area;
- A landfill located off Ardendale Road and south of South Railroad Avenue (Pines Landfill owned by Waste Management).

2.3.5 Conclusions of the HHRA

Based on the results of the HHRA as summarized above, risks above ~~regulatory targets~~10^{-4} and hazards above one were not identified for any of the receptor scenarios evaluated in the risk assessment with the exception of monitoring wells in the immediate vicinity of Yard 520 and in limited wetland areas. Based on USEPA's request, COCs have been identified as those constituents with risks greater than 10^{-6} and/or a target endpoint HI of one. These are shown on Tables 1 and 2. Potential risks greater than 10^{-6} were identified for the residential receptor, the outdoor worker, the recreational child, and the recreational fisher. No potential risks above 10^{-6} were identified for the construction worker.

The drinking water risk assessment identified potential risks above ~~regulatory targets~~10^{-4} and a hazard index of one in two wells (MW111 and MW122) located outside the MWSE area and in limited wetland areas that are unlikely to be developed, though such development in the future cannot be precluded; and a subset of wells located in close proximity to Yard 520 (MW-3, MW-6, MW-8, MW-10, TW-12, TW-15D, TW-16D, TW-18D), which are located inside the municipal water service area (see Figure 10). Municipal water is available in the area of Yard 520, and it is unlikely that the wetland areas would be developed; however, municipal water could be extended to these areas in the unlikely event they were to be developed in the future. One background well (MW120) and one well in the area serviced by the MWSE impacted by septic systems (MW104) had potential risks above 10^{-6} (in the 10^{-5} range).

2.3.6 Supplemental Risk Evaluations

Post-RI sediment and surface water data have also been collected. A review of the sediment data indicates that the majority of the constituents detected are below the screening levels used in the HHRA and therefore not of concern for the HHRA; concentrations of As and Mn exceed screening levels. However, the concentrations are lower than the Brown Ditch sediment concentrations used in the HHRA, and no further evaluation of post-RI sediment data is warranted.

The post-RI surface water data showed levels of a few constituents greater than screening levels and concentrations greater than those evaluated in the HHRA. A risk assessment for the recreational child and the recreational fisher was conducted using these data and following the methods used in the HHRA. This risk assessment is included in Attachment D of Appendix B.

The evaluation indicates that potential risks associated with potential ingestion of fish containing As are within the low end of USEPA's risk range of 10^{-4} to 10^{-6}, and that the potential hazard index associated with potential ingestion of fish containing Mn is above USEPA's acceptable hazard index of one. The results presented here are based on the maximum constituent values for the two samples. Fish tissue exceedances were not identified in the HHRA based on the RI surface water data, and these results are not of any concern because fishing (and subsequent fish ingestion) is not a common use of Brown Ditch.

It should be noted that Mn is also present in upgradient surface water samples. As provided in the RI Report, Mn was detected in all 44 upgradient surface water samples analyzed for total Mn. Total Mn concentrations in the upgradient samples ranged from 38.4 micrograms per liter (ug/L) to 2,570 ug/~~l~~L; with an average of 197 ug/L. More recent upgradient surface water samples (SW001 and SW002) are also within this range. The maximum detected concentration used to calculate the potential hazard indices in this risk evaluation of 571 ug/L is within the range of the concentrations detected in upgradient surface ~~-~~water samples.

During the period between the field investigation (2006/2007) and the present (June 2012), two seeps were identified on the western side of Yard 520 along Birch Street. A seep observed in April 2010 was inspected by USEPA and samples were collected by the Respondents for laboratory analysis. These results have been quantitatively evaluated in Attachment E of Appendix B. The total potential carcinogenic risk is well below the low end of USEPA's risk range of 10^{-4} to 10^{-6}, and the total hazard index is well below USEPA's acceptable hazard index of one. Therefore, based on the existing seep data, potential risk due to exposure to seeps that may occasionally occur is insignificant.

2.4 Ecological Risk Assessment

An Ecological Risk Assessment (ERA) was conducted as part of the RI/FS in order to evaluate the potential risks to ecological receptors posed by CCB-derived constituents of potential ecological concern (COPECs) in environmental media within the Area of Investigation. This ERA was conducted in a tiered manner and consisted of a SERA, composed of Steps 1 and 2 in USEPA's ecological risk process, and a COPEC refinement step, representing Step 3a of the process. Step 3a was conducted as part of the uncertainty analysis. The uncertainty analysis also considered a number of other sources of uncertainty which could over- or under-estimate risks to ecological receptors within the Area of Investigation.

2.4.1 Potential ecological receptors and habitats

Potential ecological receptors and habitats within the Area of Investigation were characterized through assessment of available maps, historical information, existing field data, literature results, media concentrations, available biological inventories, regulatory agency information regarding sensitive species and habitats (e.g., threatened and endangered species), etc. A reconnaissance was conducted as part of the SERA to identify local biota and habitats, to focus the ERA on areas of potential ecological habitat within the Pines Area of Investigation and to provide context for the development of the conceptual site model (CSM). This assessment identified several potential aquatic exposure areas (i.e., Brown Ditch, open water pond habitats, and wetland areas associated with Brown Ditch), as well as terrestrial exposure areas where suspected CCBs or CCB-derived constituents may be present.

2.4.2 SERA

The SERA was conducted using the maximum detected concentrations of constituents in sediment, surface water, and suspected CCB samples collected from within the Area of Investigation. COPECs were selected based on comparison of media concentrations against well-established, conservative criteria or screening benchmarks, referred to as ecological screening values (ESVs) and an evaluation of consistency with background. COPECs were further evaluated in conservative food web models designed to assess potential risks to wildlife receptors in aquatic and terrestrial habitats. HQs were calculated as the detected concentration (or dose) divided by the appropriate ESV (or dose-based toxicity reference value [TRV]). The HQ is not a predictor of risk but rather is an index used to indicate whether or not there is potential risk. An HQ equal to or above 1 indicates the potential for adverse effects and further evaluation of potential risk is conducted.

At the end of the SERA, a scientific/management decision point (SMDP) is reached, where a conclusion can be made that (1) the available data indicate there is potential for ecological risk and further evaluation is warranted, (2) the available data indicate either no or low potential for ecological risk and no further work is warranted, or (3) there are data gaps that must be addressed before the presence or absence of risk can be concluded (e.g., additional sampling or analysis). Some exposure pathways for some ecological receptors were eliminated from further consideration at this point. However, other receptors and COPECs warranted further evaluation.

2.4.3 SERA Refinement

Step 3a of the USEPA's ecological risk process was included in the uncertainty section and represents a refinement to the SERA, where COPECs identified in the conservative Steps 1 and 2 evaluations were reviewed considering additional site-specific factors. The refinement of COPECs is designed to address several of the uncertainties in the SERA and present a more site-specific evaluation of potential risks to wildlife receptors. This step considered alternative EPCs, alternative ESVs, including both no observed adverse effect level- (NOAEL) and lowest observed adverse effect level (LOAEL)-based TRVs, and more realistic exposure scenarios for the food web models, including area use factors (AUFs). An additional background evaluation was also conducted for the Brown Ditch sediment dataset to allow consideration of the influence of depositional environments (e.g., percent fines) on the distribution of metals in comparison to the background dataset. Only COPECs, pathways, and receptors retained in this step would be subject to additional evaluation within a Baseline ERA (BERA). The sub-sections below summarize the results of the COPEC refinement for the aquatic and terrestrial exposure areas.

2.4.3.1 Aquatic Environment

The aquatic environment within the Area of Investigation consisted of the Brown Ditch tributary system and several ponds located to the north of the eastern branch of Brown Ditch. Brown Ditch and the pond exposure area were assessed as separate exposure areas in the ERA. Ecological receptors may be exposed to sediment, surface water, groundwater, and/or food items within these environments. The following assessment endpoints were addressed through comparison of media concentrations to appropriate ESVs or through food web modeling:

- Protection and maintenance of freshwater benthic invertebrate populations;
- Protection and maintenance of fish and water column invertebrate communities;
- Protection and maintenance of indigenous wetland plant community;
- Protection and maintenance of indigenous amphibian community; and
- Protection and maintenance of semi-aquatic wildlife receptors (i.e., wildlife receptors expected to forage or breed within the aquatic habitat areas).

Potential impacts to benthic invertebrates, fish and water column invertebrates, wetland plants, and amphibians were evaluated through the comparison of media concentrations (i.e., sediment and surface water) to ecological benchmarks. HQs were generally lower in Brown Ditch than in the pond exposure area. Based on the results of this analysis (Table 3), further evaluation of potential risks to the benthic community, aquatic community, wetland plant community, and amphibian community within Brown Ditch and the pond exposure areas is not warranted.

The exposure pathways evaluated for avian and mammalian wildlife receptors within the aquatic environment included ingestion of prey (i.e., benthic invertebrates, fish), ingestion of plants, inadvertent ingestion of the sediments, and drinking surface water. The refined food web models considered reasonable maximum and average EPCs, NOAEL- and LOAEL-based TRVs, and site-specific AUFs[3]. The Brown Ditch food web model identified two HQs equal to or above 1 under the refined exposure scenario (i.e., average EPC and LOAEL-based TRV) and the pond exposure area food web identified two HQs that are less than 1.5, and one HQ that is less than 10 under the refined exposure scenario. The sources of uncertainty in the food web model are expected to over-estimate potential risks. ~~Findings from the percent fines normalized background evaluation also indicated that risks to wildlife receptors foraging within the Brown Ditch system and the pond exposure area due to several COPECs are expected to be similar to background risks.~~ Therefore, further evaluation of potential risks to wildlife in the aquatic exposure areas is not warranted.

2.4.3.2 IDNL

The IDNL is considered a significant regional ecological resource so the evaluation of potential risks to receptors in the IDNL is discussed separately from the other aquatic exposure areas. Groundwater within the Area of Investigation generally flows towards and into Brown Ditch which eventually flows into the IDNL. Once in the IDNL, the ditch takes a turn to the northeast and flows into Kintzele Ditch, which then flows to Lake Michigan. Brown Ditch is not known to contain economically, recreationally, or ecologically sensitive species and communication with IDNR Division of Fish and Wildlife staff (Tom Bacula) indicates that within the IDNL, Brown Ditch might be expected to contain minnows, shiners, bullhead, carp, chubs, suckers, bluegill, bass, and possibly bowfin.

The sediment sample collected from Brown Ditch in closest proximity to the IDNL (SW027) indicates that low levels of COPECs are present within the ranges observed within the upgradient data set. Concentrations of COPECs detected in SW027 were below the screening level ESVs, except for Ba and Se which were below the refined ESVs. Concentrations of COPECs within IDNL sediments would likely be lower than the levels observed in SW027.

The surface water sample collected from Brown Ditch in closest proximity to the IDNL (SW009) indicates that low levels of COPECs are present within the ranges observed within the upgradient data set. With the exception of Fe, concentrations of COPECs detected in SW009 were all below the refined ESVs for the protection of aquatic life. Surface water concentrations of all wetland COPECs, except Fe, are below levels associated with phytotoxicity.

Concentrations of all root zone groundwater COPECs in the monitoring wells closest to the IDNL (MW123 and MW110) are below the associated ESVs, indicating that impacts to plants in the IDNL are not expected.

Groundwater within the Area of Investigation generally flows towards and into Brown Ditch which eventually flows into the IDNL. A review of the groundwater elevation contours over the course of the RI as well as the constituent data, as presented in the RI Report (AECOM, 2010), indicates that the constituent distribution in groundwater is largely controlled by the groundwater and surface water elevations, and there is no indication of dramatic changes in the elevations across the seasons sampled during the RI. Significant concentrations of CCB-related constituents are not currently migrating in groundwater towards IDNL, and based on the information provided in the RI Report, are not expected to migrate there in the future in the absence of major unforeseen changes to the groundwater flow system.

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[3] The community-level screening benchmarks and wildlife TRVs used do not generally account for possible synergistic, antagonistic, or additive effects of COPEC mixtures in environmental media. These factors may result in an under-estimate or over-estimate of potential risk.

These results do not indicate sediment, surface water, or groundwater transport of CCBs into the IDNL at levels that would result in significant adverse impacts to aquatic receptors, benthic receptors, or aquatic or wetland plants in the IDNL.

2.4.3.3 Terrestrial Environment

The evaluation of the terrestrial environment within the Area of Investigation focused on areas of overlap between terrestrial ecological habitats and locations where CCB materials were placed. Ecological receptors may be exposed directly to suspected CCB containing materials or to food items within these environments. The following assessment endpoints were addressed through comparison of media concentrations to appropriate ESVs or through food web modeling:

- Protection and maintenance of indigenous terrestrial plant and soil invertebrate communities in upland habitat areas; and
- Protection and maintenance of terrestrial wildlife receptors (i.e., wildlife receptors expected to forage or breed within upland habitat areas).

The exposure pathway evaluated for terrestrial plants and invertebrates included direct contact with CCB-derived COPECs in soil. This pathway was evaluated through the comparison of suspected CCB concentrations to ecological benchmarks. This evaluation indicated that, in general, risks to these receptors are expected to be acceptable and similar to risks in areas outside the Area of Investigation. Some elevated HQs were noted (B, Cr, and V for plants; Cr and Fe for earthworms), although the confidence in the ESVs resulting in these HQs is low. In addition, the suspected CCB dataset included deep samples that are likely not in contact with soil invertebrates or plants and the dataset is focused on CCB-materials (un-sampled areas may contain more of a mix of CCBs and native soils with lower levels of COPECs). Based on the results of the CCB visual inspections conducted under the RI, an evaluation was conducted of areas of potential ecological exposure (see Appendix Q of the SERA Report) and it was determined that CCBs made up no more than 45% of the ground surface material and in some cases covered less than 25% of the ground surface area. Thus, the assumption that 100% of the soil exposure for terrestrial receptors comes from CCBs over-estimates potential risks.

The potential exposure of avian and mammalian receptors to COPECs from soil and food items (via bioaccumulation) was evaluated in a food web model. The refined food web model considered reasonable maximum and average EPCs, NOAEL- and LOAEL-based TRVs, and site-specific AUFs. The food web model identified four HQs above 1 but below 4 under the refined exposure scenario (i.e., average EPC and LOAEL-based TRV) for the evaluation of risks to the terrestrial wildlife community within the Area of Investigation due to exposure to CCB-related COPECs. The potential risks to birds due to the ingestion of CCB-containing materials used as grit was also conducted. This food web model identified two HQs above 1 but below 3 under the refined exposure scenario (i.e., average EPC and LOAEL-based TRV). Several conservative assumptions in the terrestrial food web model (e.g., 100% bioavailability, use of suspected CCB dataset to represent surface soil exposure) and the grit ingestion evaluation are likely to over-estimate potential risks to wildlife.

The community-level screening benchmarks and wildlife TRVs used do not generally account for possible synergistic, antagonistic, or additive effects of COPEC mixtures in environmental media. These factors may result in an under-estimate or over-estimate of potential risk.

Based on the results of this analysis (Table 3), further evaluation of potential risks to terrestrial receptors is not warranted.

2.4.4 Conclusions of ERA

At the completion of the SERA and the Refined SERA, an SMDP is reached where a conclusion can be made that (1) the available data indicate there is potential for ecological risk and further evaluation is warranted, (2) the available data indicate either no or low potential for ecological risk and no further work is warranted, or (3) there are data gaps that must be addressed before the presence or absence of risk can be concluded (e.g., additional sampling or analysis). To reach the SMDP, the risk assessment team communicates the results of the ERA to the risk manager and the risk manager determines whether the information available is adequate to make a risk management decision regarding the need to proceed with further, in-depth, evaluations.

Based on the results of the ERA conducted for the Pines Area of Investigation, the available data indicate no or low potential for ecological risk to aquatic and terrestrial receptors within the Area of Investigation.

3.0 Preliminary Evaluation of ARARs

This section presents potential ARARs for the Pines Area of Investigation. As per AOC II (Section IV, 10), the Respondents are required to conduct all RI/FS activities for the Pines Area of Investigation in accordance with ~~the Comprehensive Environmental Response, Compensation and Liability Act (~~CERCLA~~),~~, the National Contingency Plan (NCP), and all applicable USEPA guidance, policies, and procedures. Further, Task 6 in the SOW attached to AOC II (i.e., Identification of RAOs) requires the Respondents to provide a preliminary evaluation of ARARs for the Area of Investigation. Thus, potential ARARs, as defined in CERCLA, the NCP and other USEPA guidance, are presented herein for the Pines Area of Investigation.

3.1 Overview of ARARs

ARARs are federal and state human health and environmental requirements that are used to help define RAOs, identify sensitive land areas or land uses, develop remedial alternatives, and direct cleanup (if needed). Section 121(d) of CERCLA and the NCP require that on-site remedial actions attain Federal environmental ARARs or more stringent State environmental ARARs upon completion of the remedial action, or otherwise formally waive the ARARs.

The NCP defines two types of ARARs: applicable requirements, and relevant and appropriate requirements.

1. "Applicable" requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, or other circumstance found at a CERCLA site. Only state standards that are more stringent than federal standards, have been promulgated at the state level (i.e., are legally enforceable and generally applicable), and have been identified by the state in a timely manner may be applicable.

2. "Relevant and appropriate" requirements are those cleanup standards, standards of control, and other substantive requirements under federal and state environmental and facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, or remedial action, address situations sufficiently similar to those encountered at the CERCLA site so that their use is well suited to the particular site. As with applicable requirements, only state standards that are more stringent than federal standards, have been promulgated at the state level (i.e., are legally enforceable and generally applicable), and have been identified by the state in a timely manner may be relevant and appropriate.

"Applicability" is a legal determination of jurisdiction of existing statutes and regulations, whereas "relevant and appropriate" is a site-specific determination of the appropriateness of existing statutes and regulations. Therefore, relevant and appropriate requirements allow flexibility not provided by applicable requirements in the final determination of cleanup levels. Relevant and appropriate requirements apply only to on-site response actions, while applicable requirements are universally applicable.

Other requirements “to be considered” (TBC) are federal and state non-promulgated advisories or guidance that are not legally binding and do not have the status of potential ARARs (i.e., they have not been promulgated by statute or regulation). However, if there are no specific ARARs for a constituent or site condition, then guidance or advisory criteria should be identified and used to ensure the protection of human health and the environment. For example, TBC advisories, criteria, or guidelines available in risk assessment guidance can be used to set cleanup targets where no ARARs address a particular situation.

Under the description of ARARs set forth in the NCP and the Superfund Amendments and Reauthorization Act, state and federal ARARs are categorized as:

- Chemical-specific: governing the extent of cleanup with regard to specific constituents;
- Location-specific: governing site features such as wetlands, floodplains, and sensitive ecosystems, and pertaining to existing natural and manmade site features such as historical or archaeological sites; and
- Action-specific: pertaining to the proposed site remedies and governing the implementation of the selected remedy.

ARARs for the Pines Area of Investigation have been identified based on a review of federal and State of Indiana requirements that regulate circumstances similar to those found in the Area of Investigation.

3.2 Chemical-Specific ARARs

Chemical-specific ARARs are typically health-based or risk-based numerical values or methodologies that establish site-specific acceptable constituent concentrations or amounts. They can dictate the extent of remediation by providing either actual remediation goals or the basis for calculating such goals. Chemical-specific ARARs for the Pines Area of Investigation are summarized on Table 4, and are described below.

3.2.1 Groundwater

The federal National Primary Drinking Water Regulations established under the Safe Drinking Water Act (SDWA) provide maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) for selected organic and inorganic chemicals in groundwater. MCLs are potentially relevant and appropriate during a CERCLA cleanup for groundwater that is a current or potential source of drinking water (USEPA, 1991a). MCLs are only applicable where groundwater undergoing a CERCLA remedial action is delivered through a public water supply system, if that system has at least 15 service connections or serves at least 25 year-round residents. As stated by the USEPA in its CERCLA Compliance with the SDWA Fact Sheet (USEPA, 1991a), CERCLA projects rarely treat tap water, so there will be few instances where MCLs are applicable for groundwater cleanup.

MCLGs are non-enforceable health goals for public water supply systems (they are set at levels that would result in no known or expected adverse health effects with an adequate margin of safety). Under the NCP, the USEPA requires that MCLGs set at levels above zero (i.e., non-zero MCLGs) be considered a potential ARAR in instances where MCLs have not been established for a particular compound of concern (USEPA, 1991a).

To determine the status of MCLs and MCLGs as ARARs for the Pines Area of Investigation, groundwater classification in the Area of Investigation was examined. Indiana’s Groundwater Quality

Standards (GQS) (327 IAC 2-11) provide groundwater protection to wells and allow for the classification of groundwater. The rule states that all groundwater of the state shall be classified as "drinking water class" groundwater unless it is classified as: "limited class" groundwater or "impaired drinking water class" groundwater. In the Pines Area of Investigation, the groundwater has not been classified as limited class or impaired drinking water class, thus the groundwater is considered drinking water class groundwater. It is noted that a request for reclassification of the groundwater can be made, but until that occurs, groundwater is considered drinking water class.

Groundwater in the Area of Investigation is tapped by some households for potable use (other households have access to a municipal water supply). However, groundwater is typically tapped for potable use on an individual basis, and, to our knowledge, a single well does not serve more than 25 year-round residents. Thus, for the Pines Area of Investigation, the federal MCLs and non-zero MCLGs are not *applicable* (as explained above), and thus are only considered *relevant and appropriate* for the Pines Area of Investigation.

As stated above, state standards that are more stringent than their respective federal standards are also ARARs. Thus, Indiana's GQS regulations (327 IAC 2-11) were examined. The GQS were promulgated to maintain and protect the quality of Indiana's groundwater, and ensure that exposure to the groundwater will not pose a potential threat to human health, any natural resource, or the environment. These standards (327 IAC 2-11(e)) state that no person shall cause the groundwater in a drinking water supply well to have a contaminant concentration that creates one (1) or more of the following:

- An exceedance of the numeric criteria established in the Indiana GQS regulations for drinking water class groundwater;
- A level sufficient to be acutely or chronically toxic, carcinogenic, mutagenic, teratogenic, or otherwise injurious to human health based on best scientific information;
- An exceedance of one or more of the following indicator levels: chloride at 250 ~~milligrams per liter (~~mg/~~l),~~L, sulfate at 250 mg/~~l~~L, total dissolved solids at 500 mg/~~l~~L, or total coliform bacteria at nondetect; or
- Renders the well unusable for normal domestic use.

These standards apply at a drinking water supply well, which is defined by the GQS as a bored, drilled, or driven shaft or a dug hole that meets the following:

- Supplies ground water for human consumption.
- Has a depth greater than its largest surface dimension.
- Is not permanently abandoned.

Given the above definitions, the Indiana GQS are *applicable* to drinking water wells in the Area of Investigation (i.e., no other service connection or population served minimums are denoted in the GQS).

A final chemical-specific ARAR identified for groundwater included the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR §192.12). While these regulations are only applicable to the control of residual radioactive material at designated processing or depository sites under Section 108 of the Uranium Mill Tailings Radiation Control Act (UMTRCA), USEPA has suggested (and provided guidance[4]) where these criteria should be considered relevant and appropriate at other CERCLA sites, and, as such are considered so for the Pines Area of Investigation. The regulations identify a standard of 5 pCi/g above background for use of assessing the combined levels of Ra-226 and Ra-228.

One TBC criterion was identified for the Pines Area of Investigation. The USEPA RSLs are developed by the USEPA using risk assessment guidance for the USEPA Superfund program. They are risk-based concentrations derived from standardized equations combining exposure information assumptions with USEPA toxicity data. The RSLs are generic; they are calculated without site-specific information.

An RSL is typically used for initial site "screening~~".~~." RSLs are not de facto cleanup standards and should not be applied as such. The RSLs' role in site "screening" is to help identify areas, constituents, and conditions that require further evaluation at a particular site. Generally, at sites where constituent concentrations fall below RSLs, no further action or study is warranted under the Superfund program. Constituent concentrations above the RSLs would not automatically trigger a response action; however, exceeding a RSL suggests that further evaluation of the potential risks by site constituents is appropriate. As such, RSLs were used in the screening step of the HHRA for the Pines Area of Investigation. RSLs have also been included as a TBC for the Pines Area of Investigation, in the consideration of establishing RAOs.

3.2.2 Surface Water

Federal and state regulations also provide potential ARARs for surface waters. The State of Indiana has promulgated Surface Water Quality Standards (SWQS) for surface waters within the Great Lakes System (327 IAC 2-1.5) and waters not within the Great Lakes System (327 IAC 2-1). Surface waters within the Pines Area of Investigation are within the Great Lakes System, thus 327 IAC 2-1.5 apply. These regulations state that the chemical, physical, and biological integrity of the waters within the Great Lakes system shall be maintained or restored; thus, the discharge of toxic substances in certain amounts is prohibited, and persistent and bioaccumulating toxic substances shall be reduced or eliminated (these are further discussed below). Further, these regulations specify (under 327 IAC~~-~~ 2~~-~~-1.5-5) that:

- All surface waters of the state within the Great Lakes system are designated for full-body contact recreation;
- All surface waters shall be capable of supporting a well-balanced, warm water aquatic community; and
- All surface waters shall be capable of supporting put-and-take trout fishing.

For all surface waters of the state within the Great Lakes system, existing instream water uses and the level of water quality necessary to protect existing uses shall be maintained and protected. Thus, all high quality waters designated under this rule shall be maintained and protected in their present high quality without degradation, and, high quality waters designated as an outstanding national resource water (such as waters of national and state parks and wildlife refuges and waters of exceptional recreational or ecological significance) shall be maintained and protected in their present high quality without degradation. These last qualifiers apply to certain waters within the Pines Area of Investigation as follows:

[4] http://www.epa.gov/superfund/health/contaminants/radiation/pdfs/umtrcagu.pdf

- Kintzele Ditch from Beverly Drive downstream to Lake Michigan is designated as salmonid waters and shall be capable of supporting a salmonid fishery; and
- All waters incorporated in the IDNL are designated as an "Outstanding state resource waters."

The minimum surface water quality criteria that apply to waters within the Great Lakes system are described in 327 IAC 2-1.5-8. This rule states that, for all surface waters within the Great Lakes system, concentrations of toxic substances shall not exceed the criterion maximum concentration (CMC), which is an estimate of the highest concentration of a material in the water column to which an aquatic community can be exposed briefly without resulting in an unacceptable effect) or the secondary maximum concentration (SMC), which is an estimate of the highest concentration of a material in the water column to which an aquatic community can be exposed briefly without resulting in an unacceptable effect) outside the zone of initial dilution, or the final acute value (which is equivalent to 2*CMC or 2*SMC) in the undiluted discharge. For certain substances, a CMC is established and set forth in Table 8-1 of the Rule. For substances for which a CMC is not specified in Table 8-1, a CMC shall be calculated using the Tier I procedures provided in Section 11 of the rule, or if the minimum data requirements to calculate a CMC are not met, an SMC shall be calculated using the Tier II procedures provided in Section 12 of the rule. It is important to note that numeric Tier I and Tier II values are not provided in the rules; rather, the methodology for calculating such values is provided. Thus, the water quality standards established in Table 8-1 of the rule and the methodology for calculating Tier I and Tier II values are *applicable* to all waters of the state within the Great Lakes system.

There are also federal rules for surface water, including the federal Water Quality Criteria (WQC), which are non-enforceable guidelines that set concentrations of chemicals that are considered adequate to protect human health (ingestion of contaminated drinking water and/or fish) and aquatic organisms (USEPA, ~~June~~ 1990~~, PB 9234.2-09/FS~~). Federal WQC can be relevant and appropriate requirements under CERCLA if a particular circumstance exists that the WQC were designed to protect (e.g., in the Pines Area of Investigation, protection of aquatic organisms in surface water would be a scenario in which the WQC are designed to protect), unless the state has promulgated water quality standards for the specific pollutants and water body at the site. Because the State of Indiana has promulgated surface water standards, the federal WQC are not ARARs for the Pines Area of Investigation.

3.2.3 Soil and sediment

Currently, there are no promulgated federal or state chemical-specific ARARs that provide limits for the concentration of constituents in soil or sediment. Thus, no additional chemical-specific ARARs have been identified for soil and sediment in the Pines Area of Investigation. The State of Indiana's Risk Integrated System of Closure (RISC) program (IDEM, 2001) does provide soil screening levels[5]. This program was evaluated for potential inclusion as an ARAR for the Pines Area of Investigation, but was ultimately not deemed an ARAR. The RISC program was developed to promote consistency in the closure of impacted soil and groundwater sites in the State. The RISC guidance manual describes how to achieve consistent closure of impacted soil and groundwater sites using existing IDEM programs. The RISC program is considered by Indiana a non-rule policy document, which means that it does not have the full force and effect of law, and thus cannot be an ARAR for the Pines Area of Investigation. Further, RISC only applies to impacted industrial, commercial, or residential

[5] Note that these are screening levels, and are not fixed as clean-up levels; soil screening levels can be adjusted based on a site-specific risk assessment.

sites that are currently covered under existing IDEM programs. The Pines Area of Investigation is a federal Superfund Alternative site, and thus is not under a state program. However, at the request of the USEPA, the RISC program has been identified as TBC criteria, and is listed as such on Table 4.

3.3 Location-Specific ARARs

Location-specific ARARs govern site features (e.g., wetlands, floodplains, wilderness areas, and endangered species) and manmade features (e.g., places of historical or archeological significance). These ARARs impose restrictions on the conduct of activities based on the site's particular characteristics or locations. –Location-specific ARARs for the Pines Area of Investigation are summarized on Table 5, and are described below.

Requirements pertaining to wetlands and floodplains are identified as potential ARARs for the Pines Area of Investigation. Wetland-related requirements have been identified as potential ARARs because of the likelihood that wetlands exist. Floodplain-related requirements have also been identified as potential ARARs.

Other location-specific ARARs include requirements pertaining to threatened or endangered species. Indiana requirements pertaining to Restricted Waste Sites also are provided.

3.4 Action-specific ARARs

Action-specific ARARs are technology- or activity-based limitations affecting remedial actions. Action-specific ARARs generally set performance or design standards, controls, or restrictions on particular types of activities. The discussion of action-specific ARARs for the Pines Area of Investigation is postponed until the stage of the remedial process where remedial alternatives are identified and reviewed.

4.0 Remedial Action Objectives

AOC II and its attachment, the SOW, require the Respondents to identify RAOs (Task 6) as a component of the FS process, based on the results of the RI, HHRA, and ERA. Under the AOC and SOW, RAOs specific to the Pines Area of Investigation should be identified considering the following:

- Prevention or abatement of unacceptable risks (current and/or reasonable future) to nearby human populations (including workers), animals, or the food chain from hazardous substances, pollutants, or constituents associated with CCBs.
- Prevention or abatement of unacceptable risks (current and/or reasonable future) associated with CCBs due to exposures including drinking water supplies and ecosystems.
- Acceptable constituent levels, or range of levels, for appropriate site-specific exposure routes.
- Mitigation or abatement of other situations or factors that may pose threats to public health, welfare, or the environment.
- A preliminary evaluation of ARARs.

To address potential risks associated with CCB-derived constituents in drinking water, the Respondents conducted a Response Action which included extending municipal water from Michigan City to replace private wells as a drinking water source. Figure 3 shows the area which is currently served by the municipal water system. The Respondents provided municipal water to more than 290 residences and businesses in this area. This cost of this remedial action was $5,255,000, including the provision of bottled water to residents outside of the MWSE area who have requested this service. Note that the Respondents voluntarily chose to provide the extended municipal water service identified under the Amendment to AOC I, and that this response occurred well in advance of the conclusion of the RI/FS process. The results of the RI and the HHRA have shown that the extent of the municipal water service has been sufficient to protect residents from exposure to unacceptable levels of CCB-derived constituents in groundwater. Therefore, this Response Action has already addressed the primary remedial action objective, to prevent human exposure to unacceptable levels of CCB-derived constituents in drinking water. In addition, Yard 520 was closed between 2004 and 2007, and the cost for this remedy was $1,524,000. Additional RAOs have been identified for potential pathways not addressed by the original Response Action, as detailed below.

Based on the results of the HHRA as summarized in Section 2.0, risks above ~~regulatory targets~~10^{-6} or a hazard index of one were not identified for any of the receptor scenarios evaluated in the risk assessment for groundwater with the exception of groundwater in the immediate vicinity of Yard 520 (represented by wells MW-3, MW-6, MW-8, MW-10, TW-12, TW-15D, TW-16D, AND TW-18D) and in limited wetland areas (represented by wells MW111 and MW122), where there is currently no complete pathway to potential receptors. One background well (MW120) and one well in the area serviced by the MWSE impacted by septic systems (MW104) had potential risks above 10^{-6} (in the 10^{-5} range). The drinking water risk assessment identified potential risks above ~~regulatory targets~~10^{-4} and a hazard index of one in only two wells (MW111 and MW122) located outside the water service area and in wetland areas that are unlikely to be developed, though such development in the future cannot be precluded. The drinking water risk assessment also identified potential risks above ~~regulatory targets~~10^{-4} and/or a hazard index of one in a subset of wells located in close proximity to Yard 520, which are located within the municipal water service area. Based on these considerations, the following RAO was identified to address potential migration from CCBs to groundwater:

RAO 1: -Reduce the volume, toxicity, and/or mobility of CCB- and site-related COCs in the areas represented by those wells identified with COCs greater than background levels that are unaffected by site-related contamination and with risks within and/or above USEPA's target risk range of 1E-06 to 1E-04 and a target endpoint specific hazard index of 1, including, but not limited to MW-3, MW6, MW-8, MW-10, TW-12, TW-15D, TW-16D, TW-18D, MW111, and MW122.

The preliminary evaluation of ARARs indicates that all groundwater of the State of Indiana is classified as "drinking water class" groundwater unless it is classified as: "limited class" groundwater or "impaired drinking water class" groundwater. In the Pines Area of Investigation, the groundwater has not been classified as limited class or impaired drinking water class, thus the groundwater is considered drinking water class groundwater. The installation of the MWSE has been sufficient to protect residents from exposure to unacceptable levels of CCB-derived constituents in groundwater. Although only a small area within the MWSE area has the potential for drinking water risk, use of groundwater as drinking water in the MWSE area should be eliminated for the future (that is, installation of a drinking water well in the MWSE area should not be permitted). Based on these considerations, the following RAO was identified:

RAO 2: Prevent the installation of private wells and use of groundwater for drinking in all areas where COC concentrations are greater than background levels that are unaffected by site-related contamination and are associated with risks within and/or above USEPA's target risk range of 1E-06 to 1E-04 and a target endpoint specific hazard index of 1.

The following RAO is based on consideration of ARARs for groundwater and the risk-based foundation of the CERCLA program:

RAO 3: Restore groundwater to achieve and maintain ARARs including federal and state drinking water standards and ambient water quality standards,, protective levels (corresponding to risks within and/or above USEPA's target risk range of 1E-06 to 1E-04 and a target endpoint specific hazard index of 1) and/or background levels that are unaffected by site-related contamination for CCB-related constituents within a timeframe that is reasonable considering practicable response action alternatives.

The following RAOs are based on consideration of ARARs for solid media and the risk-based foundation of the CERCLA program:

RAO 4: Reduce or eliminate potential exposure to CCB- and site-related COC concentrations at or near the ground surface greater than background levels that are unaffected by site-related contamination and associated with risks within and/or above USEPA's target risk range of 1E-06 to 1E-04 and a target endpoint specific hazard index of 1.

RAO 5: Monitor groundwater upgradient and downgradient of CCB fill areas to demonstrate remedial progress and determine when potential beneficial uses of groundwater (drinking and discharge to surface water) are met (i.e., achieving and maintaining ARARs including federal and state drinking water standards and ambient water quality standards, protective levels (corresponding to risks within and/or above USEPA's target risk range of 1E-06 to 1E-04 and a target endpoint specific hazard index of 1) and/or background levels that are unaffected by site-related contamination for CCB-related constituents).

Based on the results of the ERA conducted for the Pines Area of Investigation, the available data indicate no or low potential for ecological risk to aquatic and terrestrial receptors within the Area of Investigation. Therefore, the Respondent's risk assessment team recommends no further evaluation of potential risks to ecological receptors at this time because the ERA indicates that current ecological risks are either low or almost entirely absent. However, an RAO has been identified to address the potential future migration of CCB-derived constituents in groundwater northward into IDNL at concentrations of significance:

RAO 6: Provide for the long-term protection of the IDNL from groundwater, surface water and sediment contamination originating from CCBs and site-related COCs in the Area of Investigation.

5.0 General Response Actions

In accordance with the SOW (Tasks 7.1 and 7.2), this Section identifies general response actions and areas within the Pines Area of Investigation to which the general response actions may apply.

5.1 Identification of General Response Actions

General response actions are those actions that will satisfy the RAOs. General response actions may include such remedial actions or technologies as treatment, containment, disposal, institutional controls or a combination of these (USEPA, 1988). The categories of potential general response actions for the Pines Area of Investigation are:

- No action (a required response action for CERCLA)
- Land Use Controls
- Containment
- *Ex*~~-~~ *Situ* Removal/Treatment
- *In*~~-~~ *Situ* Treatment

5.2 Areas within the Pines Area of Investigation to which the General Response Actions Apply

RAOs have been developed for CCB-related constituents in groundwater and soil within the Area of Investigation.

As detailed in Section 4.0, the HHRA did not identify groundwater risks above ~~regulatory targets~~10^{-6} and a hazard index of one for any of the receptor scenarios evaluated, with the exception of groundwater in the immediate vicinity of Yard 520 (represented by wells MW-3, MW-6, MW-8, MW-10, TW-12, TW-15D, TW-16D, ~~AND~~and TW-18D) and in limited wetland areas (represented by wells MW111 and MW122), where there is currently no complete pathway to potential receptors. One background well (MW120) and one well in the area serviced by the MWSE impacted by septic systems (MW104) had potential risks above 10^{-6} but below 10^{-4}. The drinking water pathway evaluation identified potential risks above ~~regulatory targets~~10^{-4} and a hazard index of one in only two wells (MW111 and MW122) located outside the MWSE and in wetland areas that are unlikely to be developed (but development in the future cannot be entirely ruled out). The drinking water pathway evaluation also identified potential risks above ~~regulatory targets~~10^{-4} and/or a hazard index of one in a subset of wells located in close proximity to Yard 520, which are located within the MWSE. These areas are shown on Figure 10.

Potential risks within the USEPA risk range of 10^{-4} to 10^{-6} were identified for suspected CCBs. Figure 4 depicts the information compiled about the potential locations of suspected CCBs at the ground surface within the Area of Investigation based on the visual inspections and the information presented in the RI Report (AECOM, 2010). It is clear, based on historical evidence and visual inspection, that CCBs were used as fill only in a subset of the Area of Investigation.

- Soil samples for chemical and radiological analysis were not collected from individual residential properties, and soil samples (possibly including some percentage of CCBs) have not been collected across much of the Pines Area of Investigation.

6.0 Identification and Screening of Remedial Alternatives

The approach and rationale leading to the development of remedial alternatives applicable to the Pines Area of Investigation are presented in this chapter. The approach consists of identifying technologies appropriate for the Area of Investigation and screening those technologies for effectiveness, implementability, and cost factors (Section 6.1). The rationale for selection or elimination of technologies is discussed in the screening analysis. From the technologies that pass the screening step, remedial alternatives that would achieve the RAOs are identified, and screened, as necessary (Section 6.2). Finally, the remedial alternatives that will be carried forward to the detailed analysis for the FS are summarized (Section 6.3).

6.1 Identification and Screening of Remedial Technologies

Potential remedial technologies applicable to CCB-related COCs in soil and groundwater in the Pines Area of Investigation are identified and described in Table 6. This table identifies categories (or types) of remedial action technologies appropriate for each media (e.g., general response actions such as No Action, Institutional Controls, Containment, Treatment). It also identifies the basic process options and example technologies that exist within each category, and provides a brief description of each process option.

The screening of remedial technologies is provided in Table 7. Remedial technologies are screened based on an evaluation of effectiveness, implementability and cost factors (as suggested in the USEPA Guidance Manual for Conducting RI/FS at Superfund Sites (USEPA, 1988)). A tiered approach to evaluation of these factors was taken: each identified technology was first reviewed for its effectiveness to achieve the RAOs for the Pines Area of Investigation; if that technology was deemed ineffective, it was not reviewed further. If a technology was deemed effective, then an evaluation of implementability and cost factors was conducted.

6.2 Assemble Remedial Alternatives

Remedial technologies that pass the screening step have been assembled into remedial alternatives that address the RAOs for the Pines Area of Investigation. Together, these remedial alternatives represent a range of technologies or combinations of technologies to address CCB-related COCs within the Area of Investigation.

Table 8 shows how the remedial technologies that pass the screening step were formulated into ~~four~~groundwater and soil remedial alternatives for the Pines Area of Investigation. These alternatives are further described below, and in ~~Table 9.~~Tables 9A and 9B (groundwater and soil, respectively).

Additional screening of remedial alternatives (beyond the screening conducted for the remedial technologies) is necessary only when there are many feasible alternatives available. This is not the case for the Pines Area of Investigation, and each of the technologies that pass the screening step was retained within a remedial alternative.

6.2.1 Groundwater Alternatives

Five groundwater alternatives have been identified and are presented below as GW Alterative 1 through GW Alternative 5; these are summarized in Table 9A. It should be noted that most of these alternatives would require property acquisition and/or pilot studies to be completed prior to implementation.

~~6.2.1~~6.2.1.1 GW Alternative 1: No Further Action

In accordance with the NCP, the no action remedy is used as a baseline for comparison for the other remedial alternatives~~,~~; however, the no action remedy is also an appropriate remedy for consideration. At the Pines Area of Investigation, two response actions have already been implemented: installation of the MWSE and closure of Yard 520, for a total cost of $6,749,000; thus, Alternative 1 is considered a *No Further Action* remedy rather than simply a *No Action* remedy.

The Respondents completed a major construction project to extend Michigan City's municipal water service from Michigan City to designated areas in the Town of Pines.

The agreement to conduct this work was documented in two Administrative Orders on Consent: AOC I, dated February 2003 (AOC 1, 2003), and AOC I, amended, dated April 2004 (AOC 1, Amended, 2003). The areas that received municipal water service are identified in Figure 3. In all, the Respondents provided municipal water to more than 290 residences and businesses. The completion of the MWSE has eliminated potential use of groundwater for drinking in the Area of Investigation within the areas shown in Figure 3. Costs for the MWSE project were $5,255,000.

Yard 520 is a closed permitted Restricted Waste Facility and is regulated by IDEM. Post-closure plans approved by IDEM provide the regulatory scope of requirements for Yard 520. Costs for the closure of Yard 520 were $1,524,000.

~~6.2.2~~6.2.1.2 GW Alternative 2: Land Use Controls

This alternative includes the following components, which have already been implemented in the Pines Area of Investigation and are described above for GW Alternative 1:

- MWSE; and
- Closure of Yard 520.

This alternative also includes Land Use Controls in the form of a groundwater ordinance, and deed restrictions~~, and annual reviews.~~. These controls are described in Table ~~9~~9A.

A monitoring program is included as a component of this alternative, and would provide an effective means to monitor conditions within the Area of Investigation to evaluate compliance with RAOs.

~~6.2.3~~6.2.1.3 GW Alternative 3: Monitored Natural Attenuation

This alternative includes the following components, which have already been implemented in the Pines Area of Investigation and are described above for GW Alternative 1:

- MWSE; and
- Closure of Yard 520.

This alternative also includes the following components, which are described on Table ~~9~~9A:

- Land Use Controls in the form of a groundwater ordinance, deed restrictions~~, and annual reviews~~; and
- Monitored Natural Attenuation.

The monitoring program included under GW Alternative 2 would be implemented, and ~~expanded~~supplemented to include evaluation of relevant parameters to document naturally occurring processes that reduce mass, toxicity, mobility, volume, or concentrations of constituents~~.~~ in an attempt to meet the expectation of restoring the aquifer to beneficial use. It also would provide an effective means to monitor groundwater conditions within the Area of Investigation to evaluate compliance with RAOs.

6.2.1.4 GW Alternative 4: Active Groundwater Treatment

This alternative includes the MWSE and the closure of Yard 520, which have already been implemented in the Pines Area of Investigation and are described above for GW Alternative 1:

This alternative also includes the following components, which are described on Table 9A:

- Land Use Controls in the form of a groundwater ordinance, deed restrictions; and
- Active groundwater treatment.

Active groundwater treatment would include groundwater extraction and treatment, hydraulic or reactive barriers, or phytoremediation. Active groundwater treatment would be implemented to reduce CCB-derived COCs in groundwater within the zone of capture in an attempt to meet the expectation of restoring the aquifer to beneficial use.

6.2.1.5 GW Alternative 5: Passive Groundwater Treatment

This alternative includes the MWSE and the closure of Yard 520, which have already been implemented in the Pines Area of Investigation and are described above for GW Alternative 1.

This alternative also includes the following components, which are described on Table 9A:

- Land Use Controls in the form of a groundwater ordinance, deed restrictions; and
- Passive groundwater treatment.

Passive groundwater treatment would include the installation of physical barriers (e.g., bentonite-clay slurry or sheet pile wall) to control the migration of CCB-related constituents in groundwater. Passive groundwater treatment would be implemented in an attempt to meet the expectation of restoring the aquifer to beneficial use outside the area of containment.

6.2.2 Soil Alternatives

Four soil alternatives have been identified and are presented below as Soil Alternative 1 through Soil Alternative 4; these are summarized in Table 9B. It should be noted that property acquisition may be required for most of these alternatives.

6.2.2.1 Soil Alternative 1: No Further Action

In accordance with the NCP, the no action remedy is used as a baseline for comparison for the other remedial alternatives; however, the no action remedy is also an appropriate remedy for consideration. At the Pines Area of Investigation, a response action has already been implemented: closure of

Yard 520; thus, Soil Alternative 1 is considered a No Further Action remedy rather than simply a No Action remedy.

Yard 520 is a closed permitted Restricted Waste Facility and is regulated by IDEM. Post-closure plans approved by IDEM provide the regulatory scope of requirements for Yard 520. Costs for the closure of Yard 520 were $1,524,000.

6.2.2.2 Soil Alternative 2: Land-Use Controls

This alternative includes closure of Yard 520, which has already been implemented in the Pines Area of Investigation and is described above for Soil Alternative 1.

This alternative would also include land use controls, if appropriate, to control the risk from exposure to surficial soils.

6.2.2.3 Soil Alternative 3: CCB Removal

This alternative includes closure of Yard 520, which has already been implemented in the Pines Area of Investigation and is described above for Soil Alternative 1. This alternative would also involve sampling and removal/replacement (where warranted, i.e., where concentrations are above background, within or above the target risk range of 10^{-6} to 10^{-4} and a target endpoint specific HI of 1, and where suitable fill can be obtained that can be shown to have concentrations below background, within or below the target risk range, and below concentrations in the material it is replacing) of surficial soils in residential yards, schools, and playgrounds.

This alternative could involve removal of surficial CCBs not just from residential locations, but also from vacant and undeveloped land within the Area of Investigation. Removal of surficial CCBs would be implemented to achieve a risk level within the 10^{-4} to 10^{-6} risk range or target hazard index of 1 or background.

6.2.2.4 Soil Alternative 4: Capping

This alternative includes closure of Yard 520, which has already been implemented in the Pines Area of Investigation and is described above for Soil Alternative 1. Capping may be also considered as a remedy for specific areas outside of Yard 520, as warranted. The materials used for capping would need to be shown to have concentrations of constituents below background, within or below the target risk range, and below the concentrations in the material it is covering.

This alternative mitigates direct contact exposure to CCB related constituents and controls their mobilization due to wind or precipitation/runoff, and migration to groundwater. Deed restrictions would be required to control capped areas.

~~6.2.4~~6.2.3 Additional Data Evaluation and Review

Prior to completing the selection analysis for CCB-related COCs at the ground surface within the Area of Investigation, additional data ~~discussion~~collection, evaluation, and review is necessary. Thus, the Respondents are deferring selection analysis for CCB-related COCs at the ground surface within the Area of Investigation until ~~resolution of these discussions has occurred~~specific tasks are completed.

First, additional discussion with the USEPA regarding background levels of CCB-~~related~~derived COCs within the Area of Investigation is necessary. The Respondents can demonstrate that the inclusion of background samples in the HHRA evaluation that may contain up to 1% CCBs has virtually no impact on the comparison between potential risks associated with suspected CCBs and background soils. This evaluation then establishes that potential risks associated with suspected CCBs are within the range of background, thus meeting the RAO for the Area of Investigation. Nevertheless, the Respondents will conduct additional background sampling and analysis, as proposed in Section ~~-~~ 6.2.4.1.

Second, additional discussion with the USEPA regarding the representativeness of data from the Area of Investigation representing the RME scenario for completing the risk evaluation is necessary. Direct contact exposures to CCB-related COCs at the ground surface within the Area of Investigation were evaluated in the HHRA using USEPA guidance requiring the use of the 95% UCL on the arithmetic mean as the exposure point concentration, or EPC, for risk assessment purposes. This statistical treatment was used in the HHRA for the Pines Area of Investigation when assessing CCB-related COCs at the ground surface over an individual property. Therefore, although there may be some locations where an analytical result may be higher than the 95% UCL, that result is unlikely to represent the average concentration across a given property. As described in USEPA guidance, the reasonable maximum exposure (RME) scenario is not meant to define the absolute maximum of all exposure inputs, but rather reasonable upper bounds. As discussed in the USEPA-approved HHRA Report (Section 6.5.3.2), historical information indicates that the suspected CCBs present in residential lots are expected to be the same as CCBs encountered in rights-of-way (and sampled under the MWSE SAP). Thus the MWSE sample results provide a robust data set that is a reasonably conservative representation of suspected CCBs within the Area of Investigation. ~~The~~The Respondents have concluded from the existing information that the data collected from the MWSE installation are representative of the RME scenario for the ground surface~~. This evaluation then establishes that potential risks associated with suspected CCBs are within the range~~, but USEPA views this as an uncertainty because it is possible that certain properties could contain higher concentrations of ~~background, thus meeting the RAO for the Area of Investigation~~CCB-related constituents.

~~Pending the resolution of these evaluations under applicable provisions of the SOW, approved Work Plans and Guidances, and if necessary to address CCB-related COCs at the ground surface, the following remedial alternatives will be considered, which are described in Table 9:~~

- ~~Removal/Disposal~~

~~This alternative would also include the following components, which have already been implemented in the Pines Area of Investigation:~~

- ~~Installation of the MWSE~~
- ~~Capping of Yard 520~~

~~This alternative also includes Land Use Controls in the form of a groundwater ordinance, deed restrictions, and annual reviews (described Table 9), and a monitoring program, as discussed for Alternative 2.~~

Before Soil Alternatives 3 and 4 can be quantitatively evaluated in the Feasibility Study, it is necessary to establish background concentrations of COCs in soils. Without this quantitative target, it will not be possible to design a meaningful remedy to meet the RAOs.

Therefore, as requested by USEPA, the Soil Alternatives have been presented separately, with the intention, as provided for by USEPA Comment #30, of addressing the GW Alternatives and Soil Alternatives on separate paths, before bringing them together in a final FS report.

~~6.2.4.1~~6.2.3.1 Work Plan for Additional Analysis of Background Samples – Phase I

The HHRA showed that direct contact risks associated with CCBs in residential areas were similar to risks associated with background soils. However, some of the background soil samples were determined to contain trace amounts of CCBs. Because of this, USEPA is not prepared to rely on the current background dataset without additional evaluation. Specifically, additional background samples should be tested for the presence of CCBs, and if necessary, additional background samples may need to be collected. This updated/revised background evaluation is necessary to establish RAOs and identify alternatives to meet those objectives.

In response to USEPA comments on the RI Report, the Respondents submitted a subset of five of the 25 background soil samples for microscopic analysis to confirm the field visual observations regarding the absence of CCB materials in the samples. The results of these analyses were described in the HHRA, and were summarized in Section 2.2.2 of this document. ~~In all, five~~Five of the background samples were analyzed for ~~the presence of~~particulate matter to determine if CCBs~~, and~~ are present in the samples. Three (3) of them were reported to contain trace levels of CCBs. One sample was reported to contain 1% ~~CCBs and two samples were~~bottom ash and a trace amount (<0.25%) fly ash, one sample was reported to contain ~~<1% CCBs.~~0.75% bottom ash and a trace amount (<0.25%) fly ash, and one sample was reported to contain <0.25% fly ash.

This background analysis was approved by the USEPA at the time (i.e., in its approval of the RI Report and the HHRA). Further, the Respondents have shown that the presence of these trace levels of CCBs has no effect on the conclusions of the HHRA. Nevertheless, the USEPA is now asking that soil samples used for the purpose of determining background levels of CCB-related constituents for the Area of Investigation be free of CCBs. The testing conducted to date has resulted in only two of the background samples meeting this criterion. Two samples are insufficient to conduct statistical analyses to calculate exposure point concentrations and representative background threshold concentrations.

The Respondents therefore will analyze additional background soil samples for CCB content, in order to obtain a data set that is robust for statistical analysis and calculating a background threshold value for CCB-related COCs (i.e., a minimum of 10 samples is needed).

Of the original 25 background soil samples, five have already been tested for CCBs. Of the remaining 20, sufficient sample volume remains for approximately 10 of these to be submitted for testing. Therefore, these 10 samples will be submitted to the RJ Lee Group for testing, following the same protocols as used for the previous testing.

Once the CCB analysis is completed, the number of background soil samples that are free of CCBs will be assessed, including both the two previously tested samples and the 10 additional samples. If the total number of samples meeting USEPA's criterion of being CCB-free is 10 or greater, and these samples include the representative soil types in the Area of Investigation (sand, clay, peat/organics), then these samples will be used as the revised background dataset. That is, the new background dataset would consist of a subset of samples (up to 12) from the original background dataset.

If the total number of background samples meeting USEPA's criterion of being CCB-free is less than 10, then additional background sample locations will need to be identified and sampled, in accordance with the background sampling and analysis procedures described in the Yard 520 Sampling and Analysis Plan (ENSR, ~~2005~~2005d). In this event, the Respondents would first provide a brief work plan to the USEPA for review and comment prior to conducting additional sampling. The work plan would include proposed sample locations. In addition, it is recommended that USEPA approve the sample locations in the field at the time of sample collection.

The available existing samples will be submitted for CCB testing as soon as written approval to continue is obtained from USEPA and a schedule has been agreed upon. The results will be provided to USEPA.

6.3 Summary of Remedial Alternatives

~~Four remedial~~Remedial alternatives have been developed for groundwater and soil within the Pines Area of Investigation FS. These alternatives provide a range of options to address the RAOs established for the Area of Investigation. A detailed analysis of these alternatives will be conducted, which will include a detailed description and a comparison of each alternative to the nine CERCLA criteria; action-specific ARARs will be identified during the detailed analysis.

The alternatives carried forward to the detailed analysis are:

- Groundwater
    - GW Alternative 1: No Further Action
    - GW Alternative 2: Land Use Controls
    - GW Alternative 3: Monitored Natural Attenuation
    - GW Alternative 4: ~~Additional Data Evaluation and Review~~Active Groundwater Treatment
    - GW Alternative 5: Passive Groundwater Treatment
- Soil
    - Soil Alternative 1: No Further Action
    - Soil Alternative 2: Land Use Controls
    - Soil Alternative 3: CCB Removal
    - Soil Alternative 4: Capping

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